

Industrial Waste Reduction Policy Options

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ABBREVIATIONS

ABS	absolute change in the quantity of waste generated
ADJ	adjusted change in the quantity of waste generated
BACT	best available control technology
BAPP	best available production process
BDAT	best demonstrated available technologies
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWA	Clean Water Act
DOH	degree of hazard
EIES	Electronic Information Exchange System
ENR	Illinois Department of Energy and Natural Resources
EPCRA	Emergency Planning and Community Right-to-Know
GAO	Government Accounting Office
HSWA	Hazardous and Solid Waste Amendments of 1984
HWRIC	Illinois Hazardous Waste Research and Information Center
IEPA	Illinois Environmental Protection Agency
IMES	Industrial Material Exchange Service
LQG	large-quantity generator
NEDS	National Emissions Data System
NPDES	National Pollution Discharge Elimination System
OPPE	Office of Policy, Planning, and Evaluation
OTA	Office of Technology Assessment
PCS	Permit Compliance System
POTW	publicly owned treatment works
PPIC	Pollution Prevention Information Clearinghouse
PPO	Pollution Prevention Office
RCRA	Resource Conservation and Recovery Act
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SIC	Standard Industrial Classification
SIP	State Implementation Plans
SOP	standard operating procedure

ABBREVIATIONS (continued)

TDP	transferable discharge permit
TPPA	Illinois Toxic Pollution Prevention Act
TRI	Toxic Chemical Release Inventory
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TSDR	treatment, storage, disposal, and recycling
USEPA	U.S. Environmental Protection Agency

EXECUTIVE SUMMARY

The Illinois Department of Energy and Natural Resources (ENR) has prepared this report as authorized by the Illinois General Assembly in Public Act 85-1196 (Il. Rev. Stat. ch. 111 1/2 par. 7057). The report focuses on industrial waste reduction, including both hazardous and nonhazardous wastes. The primary issues addressed include

- the evolution of public policy regarding waste management,
- the current availability of data on the types and quantities of wastes generated in the industrial sector,
- steps that have been taken by industry to reduce the amount of waste generated,
- the waste reduction techniques and approaches available to industry,
- the various policy options that could be used to encourage additional waste reduction, and
- the potential effectiveness of specific policies in light of Illinois' industrial structure.

Compared to post-consumer wastes (the subject of a companion report, "Post-Consumer Waste Reduction: State Policy Options") the issues surrounding industrial waste reduction are somewhat more complex. This complexity results from the considerable diversity in the types of industries in Illinois and corresponding production processes that generate wastes. Developing policies for industrial waste reduction is therefore a difficult, although not an insurmountable, task.

In the past, the difficulties encountered in addressing waste management in the industrial sector led policymakers to focus primarily on policies directed at controlling wastes subsequent to their generation. "End-of-pipe" regulations, as they are commonly referred to, have achieved considerable success in improving environmental quality and human health and welfare. Nevertheless, it is becoming increasingly apparent that this approach will only yield additional benefits at considerable cost to society. In addition, these policies often encourage the movement of waste from one medium (e.g., land) to another, often less regulated, medium (e.g., air). Consequently, policymakers have begun to focus on multimedia waste reduction as a means of generating further improvements in environmental quality. Waste reduction involves reducing, within an industrial facility,

the amount or toxicity of waste that is generated and must therefore be treated or disposed ____ of.

Policymakers at the federal and state levels have begun to address the issue of waste reduction through a series of administrative and legislative actions. For example, the U.S. Environmental Protection Agency (USEPA) established the Pollution Prevention Office, whose major function is to take the lead for establishing USEPA's waste reduction policy. In addition, USEPA recently announced a shift in the agency's policy to focus primarily on the multimedia reduction of pollutants at their source. In a similar manner, a number of states including Massachusetts, Oregon, and California have passed legislation requiring firms to conduct audits that focus on various inputs used in industrial production processes and wastes that are generated from those processes. The main objective of these laws is to reduce the amount of wastes that are generated by industry. These laws also feature provisions for the support of technology transfer and technical assistance programs and the use of fees (taxes) to alter waste generation and management practices and fund specific waste reduction programs.

Illinois has also begun to address the issue of waste reduction with a number of pieces of legislation. The Solid Waste Management Act focuses primarily on the reduction of post-consumer waste and, in particular, solid waste. The Toxic Pollution Prevention Act, which was passed in 1989, is directed at reducing the amount of toxic wastes that are generated by industry in order to reduce the release of toxic substances into the environment. Illinois is currently considering a number of additional legislative proposals directed at waste reduction in all sectors of the economy.

To identify those opportunities that have the potential to yield the greatest benefits from waste reduction, policymakers must have accurate and comprehensive data on waste generation and management practices in Illinois' industrial sector. Unfortunately, all the data needed are not available at this time. Current data collection efforts are focused on regulated hazardous wastes and, to a lesser extent, regulated nonhazardous special wastes. Data on these types of waste indicate that a relatively small number of industries are responsible for the majority of hazardous and nonhazardous special solid wastes generated in Illinois.

Current data collection efforts are not sufficient to accurately monitor the multimedia aspects of waste reduction. Data have not been collected on many types of air emissions, as well as certain releases to the land and water. Without these data, we

cannot fully address all the issues related to developing an effective waste reduction policy. Nevertheless, in this report we use the available data to identify potential directions for a state-level policy on waste reduction in the industrial sector.

According to a recent survey, many of the industrial firms in Illinois have already begun efforts to reduce their waste generation. In the case of hazardous wastes, firms have also taken steps to reduce the degree of hazard (e.g., toxicity) associated with those wastes. But even those firms that have taken steps to reduce waste generation need to take further action.

Firms can use a number of different techniques to reduce the amount of waste they generate. In addition, firms can take specific steps to assess the potential for developing reduction techniques and achieving specific waste reduction goals. By conducting a waste reduction audit, firms can identify the types and quantities of wastes they generate as well as the production processes responsible for each waste. An audit serves the dual functions of identifying specific opportunities for waste reduction and monitoring the success of waste reduction efforts. An audit should be followed by the development of a waste reduction plan, which outlines the steps to be taken that will result in waste reduction.

Depending on the nature of the outputs produced by a particular firm and the production processes that are used, firms can employ a variety of waste reduction techniques. These techniques include

- management strategies,
- input modification/substitution,
- process modification, and
- product reformulation/redesign.

A particular firm can determine which technique(s) to employ by conducting the waste audit and considering the relative costs and benefits of adopting each technique.

Many of the costs associated with the generation and management of wastes are not borne directly by the firm. As such, the firm does not incorporate these external costs into its decisionmaking process. So, the amount of waste reduction firms implement is less than the amount that is efficient, from society's perspective.

In spite of the wide range of waste reduction techniques available, firms face a number of barriers to waste reduction: (1) a lack of information and technical ability, (2) the existing regulatory framework, and (3) technological obstacles.

In addition to the barriers just listed, firms may simply be unaware of the opportunities for waste reduction that are available. Public policy can increase the degree of success associated with efforts at waste reduction by making companies aware of these opportunities.

Three basic categories of policy options could be used to foster the adoption of one or more of the waste reduction techniques listed above. The three categories are as follows:

- ***Direct regulation***

- mandatory waste reduction audits and waste management plans
- mandatory performance standards for certain production processes
- mandatory percentage reductions in waste generation per year
- bans on certain inputs or outputs
- bans on the use of certain treatment or disposal options

- ***Economic incentives***

- taxes
- transferable discharge permits,
- subsidies
- fines

- ***Voluntary compliance programs***

- education of employees
- technology transfer and technical assistance
- positive incentives such as awards programs

We evaluated the various policy options using the following evaluative criteria: (1) desirability, (2) feasibility and acceptability, and (3) effectiveness. Desirability includes considerations of the efficiency and equity aspects of each policy option. Feasibility is assessed on the basis of ease of implementation, administration, and monitoring and enforcement. Acceptability is concerned with the possible reactions of affected parties to specific policy initiatives. Effectiveness is assessed on the basis of how likely it is that the policy will achieve the goals and objectives of policymakers.

Adopting any one policy would require making trade-offs between these criteria. For example, although taxes are clearly more efficient than direct regulation, direct regulation will, in all likelihood, be more effective than taxes, at least in the short run. In a similar manner, voluntary compliance programs rank highest on the basis of feasibility but are probably the least effective policy options available. Consequently, we recommend developing a composite policy that incorporates elements of all three categories.

Structuring a specific policy strategy for Illinois depends on determining the effectiveness of specific policy options with respect to each of the waste reduction techniques and, in turn, determining which techniques are most applicable in a particular industrial setting. In other words, the policymakers should choose policy options for the composite policy strategy based on the types of industries that are responsible for the wastes generated in Illinois.

Our policy recommendations are as follows:

1. Develop a strong policy statement reflecting the state's commitment to waste reduction and to the primacy of pollution prevention/waste reduction.
2. Form a State Industrial Waste Reduction Advisory Task Force to put recommendations into the form of legislation.
3. Develop new reporting requirements to allow quantitative assessment of waste reduction progress.
4. Develop technical assistance, research, and education programs.
5. Mandate waste reduction audits for all large-quantity generators of hazardous waste under RCRA, all those who generate more than 1000 kg/month of non-RCRA special waste, and all those subject to SARA Title III, Section 313.
6. Mandate waste reduction plans for all large-quantity and small-quantity generators of hazardous waste under RCRA, all those who generate more than 1000 kg/month of non-RCRA special waste, and all those subject to SARA Title III, Section 313.
7. Provide grants and low-interest loans to those industries that have demonstrated a viable technology or technique for significantly reducing waste generation.
8. Impose fees and taxes for those industries not complying with waste reduction efforts.

Although this report addresses a number of policy options, including those that might be used to encourage the reduction of particular wastes or the use of particular

techniques, we do not have adequate data at the present time to formulate policies this specific. What we have recommended are the first stages of a program to address the reduction of all wastes released to all media from an industrial facility. As policymakers develop better reporting requirements and more data become available, the State of Illinois can institute more specific requirements to reduce or recycle specific wastes.

CHAPTER 1

INTRODUCTION

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Illinois Public Act 85-1196 (Il. Rev. Stat. ch. 111 1/2 par. 7057; formerly House Bill 3389) has mandated that the Illinois Department of Energy and Natural Resources (ENR) submit a report to the governor and legislature on public policy options for addressing post-consumer and industrial waste reduction. Specifically, Act 85-1196 states that ENR must submit a report that

describes various mechanisms that could be utilized to stimulate and enhance the reduction of industrial and post-consumer waste in the state, including their advantages and disadvantages. The mechanisms to be analyzed shall include, but not be limited to, incentives for prolonging product life, methods for ensuring product recyclability, taxes for excessive packaging, tax incentives, prohibitions on the use of certain products, and performance standards for products; and that includes specific recommendations to stimulate and enhance waste reduction in the industrial and consumer sector, including, but not limited to, legislation, financial incentives and disincentives, and public education.

Although ENR initially considered addressing both post-consumer and industrial waste in one report, it became clear that the issues were too distinct and complex for one single study. Thus the Department is submitting two reports in fulfillment of the waste reduction study mandated by Public Act 85-1196: “Post-Consumer Waste Reduction: State Policy Options” and “Industrial Waste Reduction: State Policy Options.” This report represents the latter submission. Policymakers should consider the recommendations made in the reports together because changes in post-consumer waste generation may affect industrial waste generation and vice versa. Together, these recommendations represent a comprehensive framework for reducing all wastes generated in Illinois.

1.2 DEFINITION OF TERMS

One issue we need to resolve before discussing waste reduction activities and programs is the definition of waste reduction and other key terms. Some government

organizations and interest groups define waste reduction differently than others.

Commonly used terms include

- pollution prevention,
- waste minimization,
- source reduction, and
- waste reduction.

Similar differences arise when defining various waste reduction techniques. Some groups have suggested that the general uncertainty on the part of industry and policymakers nationwide about what constitutes waste reduction is a deterrent to the implementation of waste reduction techniques [Office of Technology Assessment (OTA), 1986].

This section describes the definitions of waste reduction used by two federal government agencies. It also describes the definition of waste reduction used by the Illinois Hazardous Waste Research and Information Center (HWRIC). The HWRIC definition is used throughout this report. Table 1-1 provides definitions of other key terms used in this report.

In its 1986 Report to Congress, the U.S. Environmental Protection Agency (USEPA) defines “waste minimization” as

the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste, or (2) the reduction of toxicity of hazardous waste, or both, so long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment (USEPA, 1986).

“Source reduction” is in turn defined by USEPA as

the reduction or elimination of waste generation at the source, usually within a process. Source reduction measures can include some types of treatment processes, but they also include process modifications, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and even recycling within a process. Source reduction implies any action that reduces the amount of wastes exiting from a process (USEPA, 1986).

Table 1-1.: Definitions of Key Terms

hazardous waste:	solid wastes considered hazardous under the Resource Conservation and Recovery Act (RCRA). Hazardous characteristics include toxicity, ignitability, corrosivity, and reactivity.
industrial waste:	waste generated through commercial or industrial activity.
multimedia:	covering all media of the environment, including air, water, and land.
off-site:	activity that takes place at a facility that is geographically separate from the location at which the waste is generated. Involves the transport of wastes to a separate facility.
on-site:	activity that takes place at the facility that generated the waste.
pollution control:	treatment and disposal techniques applied after the waste is already generated to reduce the risk posed by wastes to human health and the environment. Known as “end-of-pipe” techniques.
post-consumer waste:	waste generated in households or institutions through the consumption of products and services.
solid waste:	solid, liquid, semi-solid, and contained gaseous wastes regulated under RCRA. Does not include municipal sewage, wastewater subject to regulation under the federal Clean Water Act, or radioactive waste regulated under the federal Atomic Energy Act.
special waste:	solid industrial wastes generated through production or pollution control processes and wastes hazardous under RCRA.
waste management:	any technique or method for handling waste, including waste reduction, recycling, treatment, storage, or disposal.
waste minimization:	any reduction in the quantity of waste that is generated or subsequently treated, stored, or released to the environment. Includes waste reduction and off-site recycling.
waste reduction:	any in-plant, multimedia reduction in the quantity or toxicity of waste that is generated. Includes on-site recycling, but does not include off-site recycling.
waste:	any material that is no longer useful in its original form and must be recycled or released to the environment (e.g., air, water, or land).

OTA has defined “waste reduction” more narrowly as

in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste so as to reduce risks to health and environment. Actions taken away from the waste generating activity, including waste recycling or treatment of wastes after they are generated, are not considered waste reduction. Also, an action that merely concentrates the hazardous content of a waste to reduce waste volume or dilutes it to reduce degree of hazard is not considered waste reduction (OTA, 1986).

Both USEPA's definition of waste minimization and OTA's definition of waste reduction are intended to encourage reductions in the generation of wastes and in the quantity of waste that is subsequently treated, stored, or disposed of. The stated objective of both is to reduce the risks to human health and the environment. The only substantive difference in the two definitions is USEPA's inclusion of out-of-process recycling in the definition of waste minimization. Out-of-process recycling is not included in OTA's definition of waste reduction.

HWRIC has taken an intermediate position on the issue of whether recycling is considered waste reduction. HWRIC defines waste reduction as including all measures that can be taken within a facility to reduce the quantity and/or the toxicity of a waste. This definition includes on-site recycling but does not include off-site recycling. Off-site recycling is usually the less preferred management option because of the risk incurred in transporting wastes. If waste reduction is not feasible, however, off-site recycling is usually the preferred waste management method.

1.3 COMPREHENSIVE APPROACH TO WASTE REDUCTION

We propose a comprehensive, multimedia approach to waste reduction. Only through such a comprehensive strategy can we ensure that industry addresses all reductions in all potentially hazardous wastes. This comprehensive strategy is necessary to minimize the risks that waste generation poses to human health and the environment.

A major shortcoming of the current approach to waste regulation is that regulations typically address only specified wastes released to a specified environmental medium. Thus, current regulations create a situation where wastes may be shifted from one medium to another without any net benefit to the environment. Examples include converting a solid waste to an air emission through incineration and filtering a liquid waste to remove solids that are then landfilled. OTA (1986) has advocated shifting to a multimedia approach to regulating wastes for two reasons:

- to avoid creating opportunities for shifting waste from one environmental medium to another possibly unregulated or less regulated medium, such as has happened for some wastes that undergo land disposal rather than being discharged into waterways; and
- to include wastes that are not currently regulated, such as many air emissions.

A multimedia approach is further supported by a Government Accounting Office (GAO, 1986) report that stated that USEPA does not know if it has identified 90 percent of the potentially hazardous wastes or only 10 percent.

Figure 1-1 identifies releases of waste throughout the entire product life cycle. Waste generation takes place during all stages of the product life cycle, which include

- extraction of raw materials,
- manufacturing of inputs to the production process,
- storage and transfer of inputs at the manufacturing facility,
- manufacturing of the product,
- post-production storage of the product,
- use of the product, and
- disposal of the product.

Waste reduction can be implemented at all stages of the product life cycle. In addition, all parts of the life cycle are interrelated. Changes at any stage in the process may potentially affect the quantity of waste generated. A comprehensive waste reduction policy that covers all wastes generated and released to any environmental medium would require facilities to consider waste generation at all stages in the production process and to address all potential waste reduction options.

1.4 ORGANIZATION OF REPORT

We have organized the remainder of this report to describe the present pollution control strategy of environmental protection and what we know about wastes produced by Illinois industry; the waste reduction strategies that might be used by industry; and, finally, the policy options that the State of Illinois might consider to further promote and encourage waste reduction.

Chapter 2 describes the movement of industrial waste management policies toward waste reduction initiatives at the federal and state levels. Chapter 3 presents data on industrial waste generation and waste reduction in Illinois. We compile results from numerous data sources, discuss limitations of the data and make recommendations for reducing these limitations, and present waste generation data by industry and waste type.

Chapter 4 describes basic waste reduction techniques, addresses their technical and economic aspects, and looks at barriers to firms' implementation of the techniques. Chapter 5 evaluates a broad spectrum of policy options for promoting industrial waste reduction. These policies are grouped into the categories of direct regulation, economic incentives, and voluntary compliance programs.

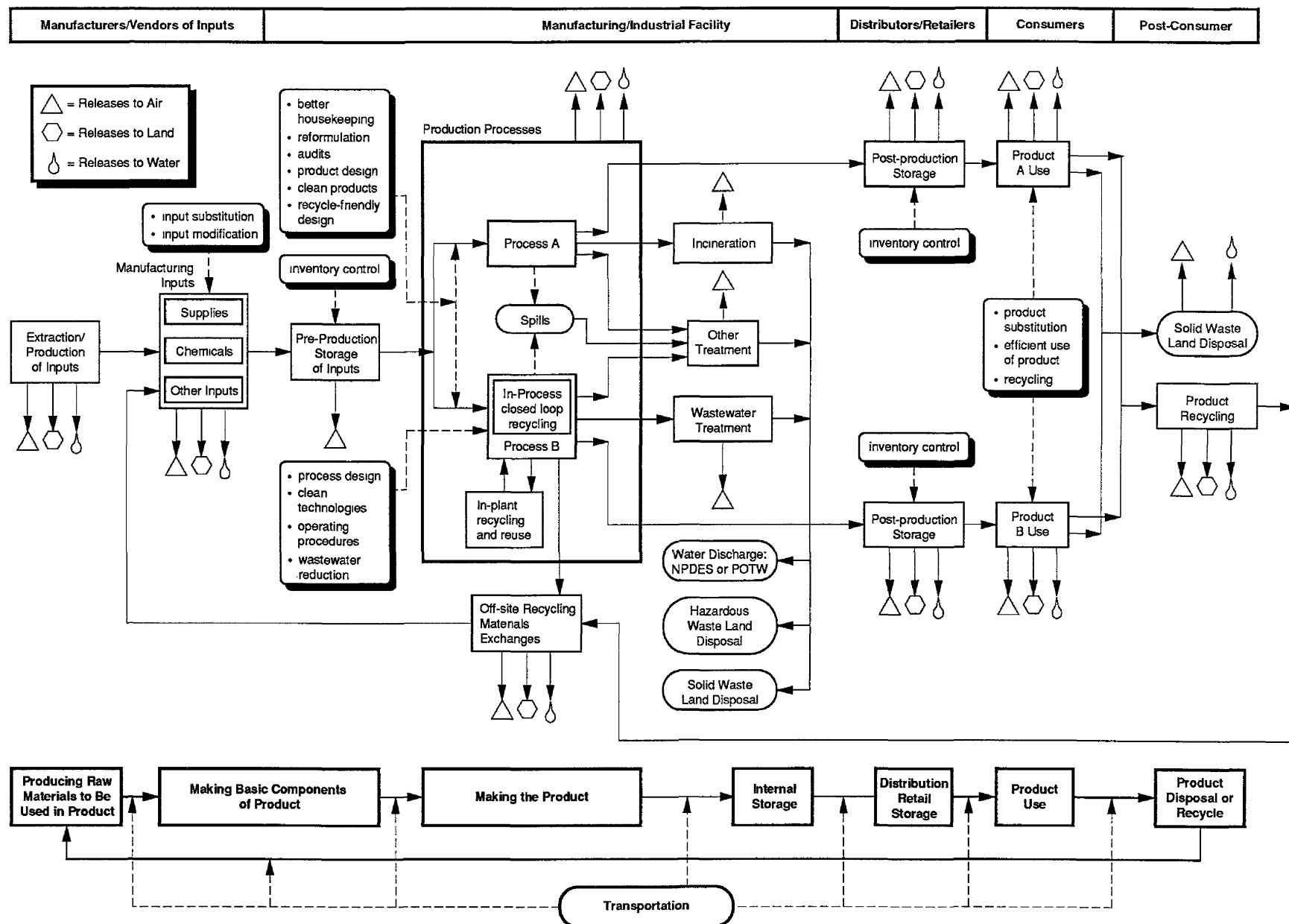


Figure 1-1. Releases to the environment during the product life cycle and associated waste reduction opportunities.

Chapter 6 evaluates the potential effectiveness of alternative policies in light of Illinois' industrial structure. In Chapter 7 we draw on the results of our evaluation to develop a package of policy recommendations designed to achieve a comprehensive and effective industrial waste reduction program in Illinois.

REFERENCES

- Office of Technology Assessment. 1986. *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency*. OTA-ITE-317. Washington, DC.
- U.S. Environmental Protection Agency. 1986. *Report to Congress: Minimization of Hazardous Waste*. Washington, DC.
- U.S. Government Accounting Office. 1986. *EPA Has Made Limited Progress in Determining the Wastes to Be Regulated*. Report to Chairman, Subcommittee on Commerce, Transportation, and Tourism, Committee on Energy and Commerce, House of Representatives, Washington, DC.

CHAPTER 2

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CHAPTER 2

FROM POLLUTION CONTROL TO WASTE REDUCTION

2.1 OVERVIEW

Current environmental regulations in Illinois emphasize pollution control techniques. That is, these regulations govern the treatment and disposal of wastes after they have been generated. Past pollution control strategies have been very successful at reducing the risk that wastes pose to human health and the environment. Nonetheless, pollution control strategies can only go so far to solve our industrial waste problems. As explained by Dr. Joseph T. Ling of 3M Company,

Pollution controls solve no problem; they only alter the problem, shifting it from one form to another, contrary to this immutable law of nature: the form of matter may be changed, but matter does not disappear. . . . It is apparent that conventional controls, at some point, create more pollution than they remove and consume resources out of proportion to the benefits derived. . . . What emerges is an environmental paradox. It takes resources to remove pollution; pollution removal generates residue; it takes more resources to dispose of this residue and disposal of residue also produces pollution [Office of Technology Assessment (OTA), 1986].

Additional environmental improvements through pollution control will be very costly and not as effective. The State of Illinois advocates shifting the focus of environmental regulations to encourage Illinois industries to implement waste reduction techniques. Waste reduction represents a fundamentally different approach to protecting the environment—waste reduction techniques reduce or eliminate the generation of wastes at their source. Through waste reduction, Illinois seeks to ensure the highest level protection of human health and the environment and to improve the efficiency of the state's industrial processes.

The remainder of this chapter describes the movement by both federal and state governments toward policies aimed at achieving waste reduction. Section 2.2 provides a brief history of the federal pollution control policies under which Illinois is currently operating and points out some of the shortcomings to this approach. Section 2.3 describes current and proposed waste reduction policies that have been initiated at the federal level, and Section 2.4 describes efforts at the state level. The effectiveness of

these policy initiatives is evaluated with respect to the basic waste reduction techniques is ... evaluated in Chapter 5, and is further examined in Chapter 6 in light of the specific characteristics of waste generation in Illinois.

2.2 A BRIEF HISTORY OF FEDERAL POLLUTION CONTROL

During the 1970s, government reacted to the knowledge that industrial waste was harming the environment and threatening public health by passing legislation requiring the development of regulatory programs. Early efforts such as the Clean Air Act, the Clean Water Act, and the Resource Conservation and Recovery Act sought to control the discharge of wastes to the water and land. This “pollution control” approach to environmental protection sought to control or reduce the toxicity of pollutants after they were produced.

During the 1980s, this pollution control approach was expanded and modified through the Hazardous and Solid Waste Amendments and the Superfund Amendments and Reauthorization Act. By the end of the 1980s, pollution control was still the primary method of environmental protection at both the national and state levels. Although pollution control laws are complex and often lengthy, the purpose of this section is to provide a brief synopsis of the federal legislation currently protecting environmental quality and public health. These regulations provide the framework for the data sources highlighted in Chapter 3.

2.2.1 Clean Air Act

The Clean Air Act (CAA) was enacted in recognition of the threat to environmental quality and public health from air pollution. Under CAA, the U.S. Environmental Protection Agency (USEPA) was granted the authority to establish minimum air quality standards, eventually known as the National Ambient Air Quality Standards (NAAQS), that state and local entities were to achieve. These standards apply to nonpoint sources of emissions, such as automobiles, and stationary sources, such as industrial facilities. If the states fail to meet these standards USEPA can take more specific regulatory actions (Frick and Wegman, 1985). In fulfilling their State Implementation Plans (SIP), which describe how states will meet the NAAQS, 32 states had deficiencies in one or more counties in 1987 (Fund for Renewable Energy and the Environment, 1987). The CAA imposes additional regulations on large quantity point sources of emissions (100 tons or more per year of a given pollutant) in areas where the

NAAQS are not attained. Examples of these regulations include requiring the use of best available control technology (BACT) and permits (Frick and Wegman, 1985).

2.2.2 Clean Water Act

The Clean Water Act (CWA), a result of amendments to the federal Water Pollution Prevention and Control Act, has the ambitious goal of eliminating all discharges of pollutants into the nation's waterways. Waterways are defined in the legislation as navigable waters, tributaries of navigable waters, interstate waterways, or intrastate lakes, rivers, and streams used for recreation, commercial fishing, or industrial purposes (40 CFR 122). Some of the major provisions of the CWA call for a permit system to require dischargers to disclose the volume and characteristics of the discharge, national effluent standards, and water quality standards (Houghton, 1987). The primary mechanism within the CWA for effective pollution control rests with the permitting program, the National Pollution Discharge Elimination System (NPDES). The NPDES requires anyone discharging waste into any of the nation's waters from a point source to apply for and receive a permit before legally resuming the discharge. Because nonpoint sources of discharges are not included in the permitting system, however, there is a large loophole in the regulation. The NPDES establishes specific performance levels that the discharger is to maintain and places the responsibility on the discharger to report when this level of performance is not reached (Arbuckle and Vanderver, 1985).

2.2.3 Safe Drinking Water Act

In 1974, the Safe Drinking Water Act (SDWA) was enacted to ensure safe drinking water supplies, protect valuable aquifers, and protect water sources from contamination due to the underground injection of waste. According to Miller (1985), few, if any, programs run by USEPA have been less enthusiastically or aggressively implemented. SDWA requires USEPA to establish drinking water standards to protect public health. The major concern of SDWA regarding hazardous waste rests with the portion of the act that prohibits the deep well injection of wastes except by permit.

2.2.4 Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act (RCRA), passed in 1976 and amended in 1978, 1980 and 1984, constitutes the most sweeping effort by the federal government to address the problems associated with the management of industrial waste. Subtitle C of RCRA creates a system to track hazardous waste from "cradle to grave."

RCRA presently identifies waste as hazardous if it displays any of four specific characteristics: ignitability, corrosivity, reactivity (instability), or extraction process toxicity (waste that is likely to leach hazardous concentrations of specific toxic constituents into groundwater under improper management conditions) (40 CFR 261). About half the wastes RCRA identifies as hazardous display one of these four characteristics (USEPA, 1988). The other half of the wastes identified as hazardous by RCRA are included on a list in Part 261 of the Code of Federal Regulations. There are over 450 wastes on this list (40 CFR 261). Generators of hazardous waste and treatment, storage, and disposal (TSD) facilities that manage it are required to identify themselves and their hazardous waste management activities to USEPA (Hall and Bryson, 1985).

The tracking of hazardous waste is accomplished through requirements placed on the generators and transporters of hazardous waste and TSD facilities handling it. Some of the requisite components of Subtitle C include a manifest system to track the movement of hazardous substances, generator reports to disclose the volume of RCRA hazardous waste generated, transporter records to be maintained, and TSD minimum technology and performance standards to be achieved, to name but a few. Much of the limited data available on hazardous waste would not exist without these RCRA requirements.

For nonhazardous solid waste, Subtitle D of RCRA provides the waste management framework. Subtitle D relegates much of the role of controlling solid waste management to state and local governments. This framework under which the state and local governments operate involves voluntary implementation of state and regional solid waste plans combined with minimum technical standards for new and existing solid waste management facilities. An example of a Subtitle D requirement is the prohibition on the disposal of solid waste in "open dumps." An open dump is defined as a disposal facility where solid waste is disposed of but which is not a sanitary landfill or a facility capable of receiving hazardous waste. Wastes regulated under Subtitle D vary from municipal wastes to some industrial and commercial wastes not identified as hazardous under Subtitle C (USEPA, 1988).

The Hazardous and Solid Waste Amendments of 1984 (HSWA) did much to strengthen RCRA. HSWA specifies steps required of USEPA to minimize and/or eliminate the extent to which land-based options are employed to dispose of hazardous waste. Included in these steps is a ban on the land disposal of several hundred hazardous chemicals and waste streams unless (1) USEPA has published treatment standards for the

waste, or (2) a petition has been approved that demonstrates there will be no migration of hazardous constituents from the disposal unit for as long as the waste remains hazardous (USEPA, 1988). In addition, under HSWA generators of hazardous waste are required to submit reports detailing any efforts they have taken to reduce the volume and toxicity of waste generated. This requirement is covered more thoroughly in Section 2.3 on federal efforts to promote waste reduction.

2.2.5 Toxic Substances Control Act

The Toxic Substances Control Act (TSCA), passed in 1977, addresses the manufacture, processing, distribution, use, and disposal of specific chemical substances. The intent of TSCA is to protect human health and the environment by requiring testing and imposing use restrictions on certain chemical products. TSCA gives USEPA the authority to regulate how a product that is made with toxic chemicals or produced in a manner that generates toxic substances is used in the marketplace. This potentially powerful authority given to USEPA by TSCA has been rarely used (Heavisides, et al., 1983).

2.2.6 Superfund Amendments and Reauthorization Act

Although the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly referred to as Superfund, is a remedial process and is not directed at pollution control, the Superfund Amendments and Reauthorization Act (SARA) does play a large part in pollution control. Title III of SARA, entitled Emergency Planning and Community Right-to Know (EPCRA), establishes annual reporting requirements for manufacturers using and generating hazardous substances. These manufacturers are required to report information on the manufacture, use, and storage of the toxic chemicals specified in Section 313 of Title III. This information is then compiled in the Toxic Chemical Release Inventory (TRI) and made publicly available. The intent of EPCRA is to increase public awareness of the presence of hazardous substances within communities and the release of these substances into the environment (USEPA, 1988).

Section 313 of SARA could also be considered a federal waste reduction effort because of its effect on many firms. Because of the availability of the TRI data to the public, several companies have already begun voluntary programs to reduce the

generation and use of toxics to avoid being identified by the public as high-volume generators and users of toxics.

2.2.7 Other Pollution Control Legislation

Other laws that affect waste management include the Occupational Health and Safety Act, the Marine Protection, Research, and Sanctuaries Act, and the Federal Insecticide, Fungicide, and Rodenticide Act. While these laws are important in preserving environmental quality they do not have a significant impact on industrial waste.

In reviewing federal initiatives, we observe two important aspects of existing regulations:

- they are media-specific and address a limited number of chemicals and wastes; and
- they address industrial waste after it has been generated.

These aspects of the pollution control regulatory structure contribute to the limitations of pollution control addressed in the next section.

2.3 FEDERAL EFFORTS TO PROMOTE WASTE REDUCTION

The federal government has begun to incorporate waste reduction in its regulatory requirements. Recently, USEPA Administrator William K. Reilly called for further moves toward waste reduction ("Single Statute Pushed by Reilly to Replace Existing Environmental Laws," *Environment Reporter*, December 1, 1989, vol. 20, no. 31, p. 1351). This section describes current and proposed federal policies to encourage industrial waste reduction.

2.3.1 Current Federal Efforts

2.3.1.1 RCRA and HSWA

The concept of waste reduction has not appeared on the state and national scene overnight. Rather, the shift in focus from pollution control to waste reduction began in 1976, with RCRA, and continues today. In RCRA, waste reduction is identified as the top priority in waste management options (Schector, 1987). With the passage of HSWA in 1984, regulations now require generators of hazardous waste to submit a biennial report detailing the generator's efforts to reduce the volume and toxicity of waste

generated.¹ HSWA also requires that generators who ship their waste off site certify they have a program “to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable” (Illinois Hazardous Waste Advisory Council, 1987).

2.3.1.2 *Pollution Prevention Office*

One of USEPA’s major program objectives is to assist and encourage the incorporation of waste reduction in state and local waste management programs (RTI, 1989). A major tool for achieving this goal was established in August 1988, with the creation of a new Pollution Prevention Office (PPO) under the Office of Policy, Planning, and Evaluation (OPPE). The major function of PPO and OPPE is to take the lead for USEPA in pollution prevention. By strategically placing this function in OPPE, USEPA incorporates the concept of pollution prevention into the basic strategies of all USEPA divisions and programs. Initially, PPO emphasized primarily outreach and information collection efforts to show industry and state programs what can be achieved through pollution prevention. Since its inception, however, PPO’s role has evolved to emphasize forming policies concerned with pinpointing the sources of pollution that need to be addressed and determining what measures are needed to address these sources (“Interview with Terry Davies, U.S. Environmental Protection Agency,” *Waste Minimization and Recycling Report*, Issue 37, pp. 10-11, December 1989).

The Pollution Prevention Information Clearinghouse (PPIC), sponsored by PPO, is dedicated to advocating pollution prevention and the reduction of industrial pollutants through the transfer of pollution prevention technology, education, and public awareness. There are four sources of information exchange available through the PPIC. The repository is a large, hard-copy reference library that contains case studies, training and education material, program and legislative reviews, and factsheets to identify industry- and process-specific waste reduction opportunities. The Electronic Information Exchange System (EIES) is a computerized bulletin board with several capabilities including a message center, calendar of events, database of case studies, and publications and program summaries. The sources provided under the outreach program target audiences to encourage the use of pollution prevention technologies. Finally, the hotline

¹In Illinois, final authorization to enforce HSWA has not been granted and the Illinois Environmental Protection Agency (IEPA) has no authority to enforce the waste reduction requirements spelled out in HSWA.

offers a free telephone service to assist callers with document searches or answer pollution prevention questions (RTI, 1989).

PPO has also developed several research components in their program. Among these components are

- the Waste Reduction Innovative Technology Evaluation Program (WRITE), a research demonstration program designed to evaluate the use of innovative waste reduction technologies;
- the Waste Reduction Assessment Program (WRAP), a program designed to develop auditing manuals and encourage the use of waste minimization assessments by industry to identify opportunities for waste reduction;
- Waste Reduction Evaluations at Federal Sites (WREAFS), a cooperative program between USEPA and other federal agencies (Department of Defense, Department of Energy, etc.) to demonstrate and encourage the adoption of waste reduction technologies; and
- Waste Reduction Institute for Scientists and Engineers (WRISE), an institute established at the University of Cincinnati composed of senior individuals knowledgeable in waste reduction to counsel USEPA and serve as a liaison to private industry generators to encourage waste reduction programs (USEPA, 1989).

2.3.2 Proposed Federal Efforts

The amount of waste reduction legislation recently introduced and considered in the U.S. Congress shows the current interest in the topic. Several bills were introduced in 1989 that propose establishing a national waste reduction office, a federal waste reduction clearinghouse, and research funds. Some of the major bills are summarized here.

2.3.2.1 SB 585

In March 1989, SB 585, the Pollution Prevention Act of 1989, was introduced in the U.S. Senate. This bill would require the establishment of an office within USEPA to carry out the requirements of the act. The functions of the office would include

- establishing standard measures of source reduction,
- coordinating source reduction activities within USEPA,
- identifying gaps in the collection of pollution data,
- developing training programs to help permit writers identify source reduction opportunities,

- identifying barriers to waste reduction and proposing measures to overcome these barriers, and
- developing source reduction audit procedures.

Other highlights of the bill include providing grants to the states, creating a source reduction clearinghouse, and establishing a national awards program for high-profile recognition of successful source reduction programs. Those companies subject to SARA 313 would be required to file reports on toxic chemical source reduction and pollution control information. In addition, USEPA would be required to conduct a waste stream survey of SARA 313 facilities in the two-digit Standard Industrial Classification (SIC) code categories registering the highest quantity of toxic releases.

2.3.2.2 *HR 1457*

Another bill introduced in the House of Representatives in March 1989 is HR 1457. The Waste Reduction Act, better known as the “Wolpe Bill” after its main sponsor, Rep. Wolpe, is comparable to legislation introduced in 1987 that proved to be unsuccessful. HR 1457 would establish an office within USEPA independent of the pollution control offices that focus on only one medium, such as water or air. The office would take an active role in advising USEPA on multimedia activities to promote waste reduction. Also included in HR 1457 is a provision for the establishment of training programs on waste reduction opportunities, annual award programs for companies successful in waste reduction activities, and a grants program that would provide matching grants to the states to promote waste reduction. Generators of wastes subject to the SARA 313 reporting requirements would also be required to file annually a toxic chemical waste reduction and recycling report. This report would include

- quantities of chemicals entering the waste stream and the percent change from the previous year,
- amount of chemicals recycled and the percent change from the previous year,
- the source reduction techniques used with respect to the subject chemicals,
- projections on percentage changes in both quantities entering the waste stream and the amount of chemicals recycled for the next two years, and
- techniques used to identify waste reduction opportunities.

2.3.2.3 *SB 1113*

A bill addressing both post-consumer and industrial waste is the Waste Minimization and Control Act of 1989. Otherwise known as the “Baucus Bill,” SB 1113 provides for many of the same things included in the aforementioned legislation, such as the creation of an Office of Waste Minimization, grants, and a clearinghouse. In addition to these proposals, the Baucus Bill establishes a mandatory efficiency standard for the use or consumption of hazardous substances. The standards would prohibit releases of hazardous substances in quantities greater than 5 percent of production throughput. The Baucus Bill also has many provisions concerning post-consumer waste reduction and waste management. For example, the bill would require USEPA to publish a list of at least ten products, with at least ten to be added each year, identified as the products that most frequently contain hazardous substances.

2.3.2.4 *HR 3693*

Introduced in November 1989 by Rep. Wolpe, HR 3693, also known as the “Pollution Prevention Act,” would provide for a clearinghouse, grants to universities for research and to states with solid waste and recycling programs to finance evaluations of these programs, and a Technology Transfer Office within PPO. The Technology Transfer Office would serve as a liaison to potential users of pollution prevention practices and techniques. HR 3693 also calls for a report to be given by USEPA on the impacts of products on pollution prevention capabilities.

2.3.2.5 *HR 3735*

The Waste Materials Management Act of 1989 (HR 3735), proposed by Rep. Lukens, would set an identification standard for identifying hazardous waste. This standard would create a uniform, concentration-based system to identify these wastes. In addition to this identification standard, HR 3735 calls for waste reduction to be considered in the formation of all measures within USEPA and provides for a solid waste reduction clearinghouse.

2.3.2.6 *Bush Administration Proposal*

In addition to the legislation proposed in the two legislative houses, the Bush Administration is developing proposed waste reduction legislation. Although the legislation is currently undergoing internal review, it is reported to include provisions for

the Pollution Prevention Office, an awards program, a clearinghouse, and grants ("Interview with Terry Davies, U.S. Environmental Protection Agency," *Waste Minimization and Recycling Report*, Issue 37, pp. 10-11, December 1989).

2.4 STATE-LEVEL EFFORTS TO PROMOTE WASTE REDUCTION

Major legislative efforts to promote waste reduction have been undertaken by individual states as well as by the Council of State Governments. These efforts are described below.

2.4.1 Individual States' Efforts

There are currently three states—Massachusetts, Oregon, and California—that require industry to take at least the initial steps required of a waste reduction program. This section details the efforts of these three states and briefly describes the efforts of a number of other states that have made steps toward developing waste reduction programs.

2.4.1.1 *Massachusetts*

In July 1989, Massachusetts was one of two states that passed legislation requiring firms to undertake the initial steps required of a waste reduction program. The Toxics Use Reduction Act (H. 6161) is aimed at reducing the amount of toxic materials used in industrial processes and discarded in waste streams. The stated goal of this act is to reduce the amount of toxic waste generated by at least 50 percent by 1997 ("Massachusetts, Oregon Enact Pollution Prevention Bills," *State Regulation Report*, vol. 9, no. 15, pp. 114-15, July 26, 1989).

The act requires two major tasks of industry. First, firms subject to the act are required to file inventory reports on the use of substances identified on a list of hazardous substances. The original list includes over 1000 chemicals, including those chemicals in Title III, Section 313 of SARA and may be expanded or reduced to adapt to any new information. Second, industry is also required to conduct reviews of their chemical use and generation of hazardous substances and wastes, and must submit plans for the reduction of these wastes. The plans are to include a statement of management's commitment to waste reduction, a process-by-process evaluation of the potential for reduction, and an overall plan to reduce the use and disposal of toxic materials. Summaries of these plans must be submitted to the Department of Environmental Protection although the full plans must stay on site.

The firms subject to the requirements of this act are defined as large-quantity toxics users (i.e., firms using greater than 10,000 pounds of toxic substances each year). There are approximately 2,400 industrial chemical users in Massachusetts that fall into the large-quantity user category. In addition, the act allows the state to require “high priority” firms to meet performance standards that are economically feasible if these firms do not meet expected goals. Firms are designated high-priority generators by the Administrative Council on Toxics Use Reduction. The goals referred to above are the planned reductions in hazardous substance use or generation required in the plans.

The act also calls for the state to increase research and technical assistance to the industrial sector. Technical assistance is or will be provided by the new Office of Toxics Use Reduction Assistance and Technology within the Executive Office of Environmental Affairs. The Toxics Use Reduction Institute was established by the act at the University of Lowell to undertake research on toxics use reduction and waste reduction and to publicize the results of this research. In addition, the Institute will host seminars, conferences, and courses to provide technical information to toxics users and will sponsor research and pilot programs.

The requirements of this act are funded through a toxics user fee. These fees include both a base fee, dependent on the number of employees at the users facility, and a charge per toxic chemical used. The maximum fees can range from \$1,500 for a small plant to \$8,500 for a large one.

The Toxics Use Reduction Act passed unanimously in both houses of the Massachusetts state legislature and signed into law by the Governor despite mild objections from the Associated Industries of Massachusetts (“Massachusetts, Oregon Enact Pollution Prevention Bills,” *State Regulation Report*, vol. 9, no. 15, pp. 114-15, July 26, 1989).

2.4.1.2 Oregon

On the same day that Massachusetts enacted the Toxics Use Reduction Act, the Governor of Oregon signed a similar piece of legislation. This legislation, the Toxics Use Reduction and Hazardous Waste Reduction Act (HB 2324), is similar to the Massachusetts law except that it does not set a specific waste reduction goal for the state. The goal of this law is to achieve in-plant changes that eliminate, reduce, or avoid the use of toxic substances and the generation of hazardous waste.

As was the case with Massachusetts, the Oregon law requires industry to carry out two major activities. First, each firm subject to the law is required to complete a toxics use reduction and hazardous waste reduction plan. To be included in each plan is a written policy articulating upper management support and commitment, plan goals and objectives, numeric reduction goals for certain toxic substances and hazardous waste streams, analysis of toxics use and hazardous waste streams, identification of reduction opportunities, and establishment of employee awareness and training programs.

Second, progress reports are due annually after the plan requirements go into effect. These progress reports are to consist of a description of how the plan is being implemented and data showing the progress made in reaching the stated reduction goals. To monitor the use of toxics and the generation of hazardous waste, each firm subject to the act is required to report the quantities of toxic substances used. These quantities can be pulled from the annual progress reports.

The firms subject to these requirements fall into three categories. First, the large users are those firms that are required to report under SARA Title III Section 313 (Federal Community Right-to-Know). Second, firms that generate more than 2,200 pounds per month of hazardous waste or more than 2.2 pounds of acutely hazardous waste (large-quantity generators) also are subject to the law. Finally, small-quantity generators of hazardous waste that generate between 220 and 2,200 pounds of hazardous waste are also covered.

Other aspects of the Oregon toxics use reduction law include expansion of the state's technical assistance program to include on-site assistance, workshops, and a public recognition program for companies achieving success under the waste reduction program. Research is to be provided by academic institutions but is subject to available funding. Funding for the program is derived from a fee based on the number of pounds of waste generated by each individual industry.

As was the case in Massachusetts, the Oregon legislation passed through both houses of the State Legislature unanimously and obtained the required signature of the Governor ("Massachusetts, Oregon Enact Pollution Prevention Bills," *State Regulation Report*, vol. 9, no. 15, pp. 114-15, July 26, 1989).

2.4.1.3 California

In October 1989, California passed the Hazardous Waste Source Reduction and Management Review Act of 1989 (SB 14). The broad goals of this legislation are threefold: (1) to reduce the generation of hazardous waste, (2) to reduce the release of chemical contaminants that have adverse health and environmental effects, and (3) to document hazardous waste management information.

The requirements of the act are numerous but can be grouped into two categories. First are the requirements placed on industry. Every four years, generators subject to this law are required to conduct a source reduction evaluation review and plan. This review and plan must identify all routinely generated hazardous waste streams. For each waste stream, the generator must estimate the quantity of hazardous waste generated and evaluate the source reduction approaches available to the generator for the reduction of the waste stream. The generator must then identify in the review and plan which source reduction techniques will be undertaken by the generator to achieve reduction of hazardous waste. The review and plan must also be certified by a professional engineer or comparable party.

The other requirements of the act are placed on the administrative agency. This requirement specifies that the State Department of Health Services (DHS) identify two categories of industries by SIC code every two years and focus on source reduction measures in these categories. This identification will require the industries to submit their plans to the state and will help DHS identify successful source reduction techniques. The administering agency will also provide technical and research assistance under the law. This assistance is to include on-site consultation, seminars and workshops, and an information clearinghouse to help educate industry about source and waste reduction.

The firms subject to the legislation are generators that routinely generate more than 12,000 kilograms of hazardous waste annually. Also subject are firms that generate more than 12 kilograms of extremely hazardous waste annually.

The implementation of the California Hazardous Waste Source Reduction and Management Review Act is funded by fees placed on the generators of hazardous waste. As of yet, there is no information available on the structure of the fee assessment system.

2.4.1.4 Other State Legislative Highlights

Other states that require waste reduction plans include Texas and Louisiana. Texas requires the generators of waste subject to the reporting requirements of Title III, Section 313 of SARA to complete a facility-wide multimedia waste reduction plan (Texas Pollution Prevention and Waste Reduction Assistance Act, 1989). Louisiana requires waste reduction plans from generators of hazardous and nonhazardous waste (Louisiana Waste Reduction Law, 1988). New Jersey is currently considering legislation requiring select industry groups to develop pollution prevention plans to show the strategies that will be followed to reduce the generation of hazardous substances (New Jersey Department of Environmental Protection, 1989). According to the State Council of Governments (1989), Wisconsin is currently requiring waste reduction audits from industry. Kentucky is also considering legislation to require waste reduction audits ("Kentucky Releases Draft Plan for Environmental Management," *State Regulation Report*, December 13, 1989).

2.4.2 Council of State Governments' Model Legislation

In 1987, the Council of State Governments, a national organization of the 50 states, created a task force to oversee the development of model legislation that the states could implement to encourage hazardous waste reduction. The result of the task force is the 1989 report entitled, *State Options for Hazardous Wastes*, which includes, among other things, a section describing model legislation that could serve as a state's hazardous waste reduction legislation (see Appendix A). The primary goal of this model legislation is to reduce the amount of hazardous waste generated in a state.

2.4.2.1 Components of the Model Legislation

Official Hierarchy. The model legislation contains four main components to achieve waste reduction. The first component concerns establishing an official hierarchy of waste management options. In order of preference, these options are as follows:

1. Reduce waste production at the source.
2. Recover and re-use resources (wastes).
3. Recycle on site, or if that is not feasible, off site.
4. Treat wastes to reduce volume and toxicity (including incineration).
5. Store wastes.
6. As a last resort, dispose of any remaining wastes in a manner that serves to protect the quality of air, water, and land resources.

Center for Waste Reduction. The second component outlines the establishment of a center for waste reduction within an existing state agency or university. The purpose of establishing this center is to assist generators of hazardous waste in their efforts to reduce the amount and/or toxicity of hazardous waste generated and to thereby reduce the adverse effects of these wastes on public health.

To fulfill this purpose the center may be required to perform a number of duties. Some of the basic duties of the center suggested in the model legislation include

- conducting clearinghouse activities for information on hazardous waste reduction technologies and procedures;
- sponsoring and conducting conferences, workshops, and seminars on hazardous waste reduction for specific classes of industry or businesses;
- analyzing innovative hazardous waste reduction technologies and procedures for feasibility;
- developing and distributing recommended hazardous waste reduction audit procedures for industry to use in internal hazardous waste audits;
- providing on-site technical assistance upon request by industry to help identify procedures with the potential for hazardous waste reduction or to complete internal hazardous waste audits;
- administering loans, loan guarantees, or grant programs;
- providing funds for research on hazardous waste reduction;
- developing necessary information base to facilitate measuring the success of hazardous waste reduction activities within the state; and
- identifying and nominating companies with outstanding successes in hazardous waste reduction for a Governor's award or some other type of public recognition.

Waste Reduction Plans. The third main component of the Council of State Government's model legislation is the requirement of hazardous waste reduction plans from both large- and small-quantity generators of hazardous waste within the state. The minimal requirements to be included in the plan begin with a written policy articulating the commitment of upper management to hazardous waste reduction. An internal analysis of hazardous waste streams is also to be included with periodic waste reduction assessments to identify new possibilities for hazardous waste reduction activities. Another requirement urges implementing a hazardous waste accounting system that identifies the true costs of hazardous waste management, such as liability, compliance,

and oversight costs. The plan is also to describe employee awareness programs that are designed to encourage company-wide commitments and employee participation in hazardous waste reduction activities. In addition, the plan must also describe how hazardous waste reduction is to be implemented, providing a listing and discussion of the hazardous waste reduction options applicable and the rationale for the options chosen to pursue waste reduction.

Generators will also be required to file an annual progress report that serves two main functions. The progress report will quantify the progress made relative to the specific performance goals set by each generator and will list and explain any amendments to the hazardous waste plan. The specific goals set by the generator are to be expressed in numeric terms wherever possible, but the model legislation does not provide any guidelines for setting these goals. It also fails to address penalties for not reaching the goals. The progress report also must include the quantities of hazardous waste generated.

After the firm completes the hazardous waste plan or progress report, the administering agency may review them to determine whether they are adequate. When notifying the state of the completion of the plan and progress report, the company is to complete and submit a form, provided by the state, to the agency in charge of administration. The legislation states that the plans are to remain on site and are to be available for review when requested by the state, but does not explain when the state reviews the plans or why.

The model legislation also provides a section that can be used as an alternative to the requirement of hazardous waste reduction plans, or can be used to supplement the plan requirement. Based on New York's Small Quantity Generator Hazardous Waste Audit Program, this alternative section could allow the state to pay contractors to perform waste audits for small-quantity generators. These audits are to identify all hazardous wastes generated, the regulatory requirements associated with treatment, storage, and disposal of such hazardous waste, and any methods, processes, or equipment that could reduce the amount of hazardous waste generated. In return, the businesses that have an audit completed for them are required to submit a waste reduction plan describing the steps to be taken to implement the waste reduction strategies identified in the waste audit.

Fees. The final main component of the model legislation concerns financing for states' hazardous waste reduction programs. The Council of State Governments

recommends state legislation concerning hazardous waste reduction include fees to be assessed on hazardous waste generators and hazardous waste facilities. In the case of the generation fee, the legislation suggests basing the assessment on the hazardous waste disclosures provided in the hazardous waste reduction plan and progress report. This fee is to be assessed annually. The fee placed on hazardous waste facilities is proposed as a permit fee requiring an annual renewal.

2.4.2.2 *Comparing Actual State and Model Legislation*

Some states have developed legislation that incorporates programs outlined in the model legislation. Table 2-1 describes state-level waste reduction efforts in relation to the model legislation. Although the table may not include all state waste reduction programs, it provides an excellent indication of current waste reduction activities at the state level. According to Table 2-1, 29 states have established an official waste management options hierarchy with waste reduction as the top priority in their hierarchy. Thirty-four states provide at least one of the functions listed in the model legislation concerning information and technical assistance, but the actual characteristics of these programs and whether their efforts are aimed at waste reduction are unknown. Many of the states that do provide one or more of the services listed have not created a center for hazardous waste reduction. Nevertheless, a few of the established centers around the country, such as the Illinois Hazardous Waste Research and Information Center (HWRIC), have had their waste reduction activities well publicized.

Thirty states impose a fee on hazardous waste generation or disposal. On the other hand, the number of states that require waste reduction plans is quite small. Only five states are identified, in the sources consulted, as currently requiring waste reduction plans. One additional state is considering legislation that would include this requirement. In half of these cases, it is unknown how these states define waste reduction and what is to be included in the mandated plan. One state currently mandates that waste audits are to be completed by generators while another is considering enacting a similar requirement.

2.5 ILLINOIS' EFFORTS TO ENCOURAGE WASTE REDUCTION

Illinois has made several efforts to encourage industrial waste reduction as a result of the federal government's efforts to incorporate waste reduction in its regulatory requirements. In addition, Illinois has enacted some legislation at the state level regarding waste reduction.

Table 2-1. Individual States' Waste Reduction Practices Compared to Council of State Government's Model Legislation

State	Major Components of CSG's Model Legislation										
	Waste Management Options Hierarchy	Mandate Industrial Waste Reduction Plans	Technical Assistance/Information Characteristics								Hazardous Waste Fees
			General Information	Seminars, Workshops, Conferences	On-site Assistance	Audits for Industry	Grants Program	Awards Program	Primary Research on Waste Reduction Techniques	Loans for Waste Reduction Activities	Generation Disposal
AL	▲		▲	▲	▲	▲		▲	▲		
AK	▲		▲	▲	▲	▲	▲				
AZ	▲		▲				▲				▲
AR			▲		▲		▲				
CA	▲	▲	▲	▲	▲	▲	▲	▲	▲		▲
CO			▲								
CT	▲		▲	▲			▲	▲	▲	▲	
DW											▲
FL			▲	▲	▲	▲		▲			▲ ^a
GA	▲		▲	▲	▲	▲		▲	▲		
HA											
ID			▲	▲	▲						▲
IL	▲		▲	▲	▲	▲	▲	▲	▲		▲

continued

Table 2-1. Individual States' Waste Reduction Practices Compared to Council of State Government's Model Legislation (continued)

State	Major Components of CSG's Model Legislation											
	Waste Management Options Hierarchy	Mandate Industrial Waste Reduction Plans	Technical Assistance/Information Characteristics								Hazardous Waste Fees	
			General Information	Seminars, Workshops, Conferences	On-site Assistance	Audits for Industry	Grants Program	Awards Program	Primary Research on Waste Reduction Techniques	Loans for Waste Reduction Activities	Generation	Disposal
IN			▲	▲	▲			▲				
IA	▲		▲	▲	▲				▲			
KS			▲	▲						▲	▲	
KY		Pending ^b	▲	▲	▲	▲				▲	▲	
LA	▲	▲	▲	▲	▲		▲		▲	▲	▲	
ME										▲	▲	
MD												
MA	▲	▲	▲	▲	▲	▲	▲	▲		▲	▲	
MI	▲		▲	▲	▲		▲	▲			▲	
MN	▲		▲	▲	▲	▲	▲	▲	▲	▲	▲	
MS												
MO	▲		▲	▲							▲	
MT										▲	▲	
NE			▲	▲	▲							
NV	▲										▲	

continued

Table 2-1. Individual States' Waste Reduction Practices Compared to Council of State Government's Model Legislation (continued)

State	Major Components of CSG's Model Legislation										
	Waste Management Options Hierarchy	Mandate Industrial Waste Reduction Plans	Technical Assistance/Information Characteristics								Hazardous Waste Fees
			General Information	Seminars, Workshops, Conferences	On-site Assistance	Audits for Industry	Grants Program	Awards Program	Primary Research on Waste Reduction Techniques	Loans for Waste Reduction Activities	Generation Disposal
NH											▲
NJ	▲	Pending ^c	▲	▲	▲	▲			▲		▲
NY	▲		▲	▲	▲	▲			▲	▲	▲
NC	▲		▲	▲	▲		▲	▲	▲		▲
ND											
OH	▲		▲	▲	▲			▲			
OK	▲		▲		▲						▲
OR	▲	▲	▲	▲	▲			▲	▲		▲
PA	▲		▲	▲	▲	▲	▲	▲			▲
RI	▲		▲	▲	▲	▲	▲	▲	▲		
SC	▲										▲
SD											
TN	▲		▲	▲	▲	▲	▲	▲	▲	▲	▲
TX	▲	▲	▲	▲	▲		▲				▲

continued

Table 2-1. Individual States' Waste Reduction Practices Compared to Council of State Government's Model Legislation (continued)

State	Major Components of CSG's Model Legislation										
	Waste Management Options Hierarchy	Mandate Industrial Waste Reduction Plans	Technical Assistance/Information Characteristics								Hazardous Waste Fees
			General Information	Seminars, Workshops, Conferences	On-site Assistance	Audits for Industry	Grants Program	Awards Program	Primary Research on Waste Reduction Techniques	Loans for Waste Reduction Activities	Generation Disposal
UT											
VT	▲										▲ ▲
VA	▲		▲	▲	▲	▲					
WA	▲		▲	▲	▲			▲	▲		▲ ▲
WV											▲ ▲
WI	▲	▲ ^d	▲	▲		▲	▲	▲			▲
WY											

^aFlorida assesses fees on treatment, storage, and disposal facilities.

^bKentucky has legislation pending that would require waste reduction audits.

^cNew Jersey is currently considering legislation requiring selected industrial groups to develop pollution prevention plans to reduce the generation of hazardous substances.

^dWisconsin currently requires waste reduction audits.

Note: The absence of a ▲ indicates either that the state does not have the practice or that insufficient data were available.

Sources: Congressional Budget Office, 1985.

Council of State Governments, 1989.

Environmental Defense Fund, 1986.

Auditor General, State of Illinois, 1989.

National Governor's Association, 1988.

Office of Technology Assessment, 1986.

State Regulation Report, December 13, 1989, "Kentucky Releases Draft Plan for Environmental Management."

2.5.1 Illinois' Present Efforts

2.5.1.1 *Resource Conservation and Recovery Act*

In Illinois, as with most states, RCRA, and subsequently HSWA, presented the first encounter with governmental requirements on waste reduction. As discussed earlier, under HSWA generators of hazardous waste are required to submit reports detailing any efforts the generator may be undertaking to reduce the volume and toxicity of wastes generated. In Illinois, however, final authorization to enforce HSWA has not been granted. As a result, the Illinois Environmental protection Agency (IEPA) has no authority to enforce the waste reduction requirements spelled out in HSWA (Auditor General, 1989). Generators in Illinois are required to submit an annual report to IEPA (35 Ill. Administrative Code 722), however, that describes the company's waste reduction efforts and estimates the amount of hazardous waste reduced compared to prior years (Auditor General, 1989).

Data from the IEPA Annual Reports are incomplete and do not give an accurate measure of the amount of waste reduction occurring in Illinois. In a 1985 review of the IEPA Generator Annual Hazardous Waste Report, HWRIC found that 54 percent of the reports submitted lacked a description of the generator's efforts to reduce hazardous wastes. The Auditor General of Illinois performed a similar study two years later and found 22 percent did not include a waste reduction statement (Auditor General, 1989). In addition, 73 percent of the reports did not compare changes in waste generation actually achieved although the reporting of this information is required.

2.5.1.2 *Illinois Solid Waste Management Act*

Illinois has enacted several other pieces of legislation that further the pursuit of waste reduction within the state. The Illinois Solid Waste Management Act (SWMA) (PA 84-1319) gives waste reduction priority status over other waste management strategies. The established hierarchy is

1. volume reduction at the source,
2. recycling and reuse,
3. combustion with energy recovery,
4. combustion for volume reduction, and
5. disposal in landfill facilities.

2.5.1.3 Toxic Pollution Prevention Act

In September 1989, the Illinois Toxic Pollution Prevention Act (TPPA) was approved and signed into law as Public Act 84-1319. The purpose of the act is to reduce the disposal and release of toxic substances into the environment, to promote toxic pollution prevention as the most preferred means of achieving compliance with environmental laws and regulations, to establish state programs that provide high-level attention to toxic pollution prevention policy initiatives, to integrate existing regulatory programs to promote toxic pollution prevention, and to stimulate toxic pollution prevention strategies by industries.

The TPPA establishes several different programs to fulfill these purposes. One is the Toxic Pollution Prevention Program established in IEPA. This program serves three purposes:

1. Identify all state and federal laws or regulations pertaining to waste disposal and release of toxic substances into the environment, and promote coordination of efforts to administer and enforce these laws and regulations.
2. Establish procedures for expediting permit application review for process and/or equipment modifications that involve toxic pollution prevention.
3. Develop a list of toxic substances to receive priority attention for toxic pollution prevention.

Another component of the TPPA is HWRIC's establishment of the Toxic Pollution Prevention Assistance Program. HWRIC's duties in carrying out this component are numerous and include those duties the Center *shall* and *may* perform. The duties the Center *shall* perform include

- providing general information and actively publicizing the advantages of and developments in toxic pollution prevention; and
- engaging in research on toxic pollution prevention methods.

The duties the Center *may* perform include

- establishing cooperative programs with public or private colleges;
- establishing fees or tuition for participation in the program;
- establishing courses or seminars to promote toxic pollution prevention technology or knowledge;

- developing and providing curriculum and training for students and faculty on toxic pollution prevention;
- providing on-site technical assistance to identify opportunities for toxic pollution prevention plans; and
- sponsoring pilot programs or projects to develop and demonstrate toxic pollution prevention.

The TPPA also includes a section on toxic pollution prevention innovation plans. Under this section, any person *may* submit to IEPA a plan that proposes to achieve toxic pollution prevention through innovative production processes and/or new applications of technology. The plan is to include a description of the innovative production process or technology, the benefits expected from implementation of this innovation, the proposed implementation schedule, and any possible problems. IEPA can concur with the plan or reject it based on potential compliance problems, prior experience with the process or technology change, comparison to other available processes, and with the assurance that there will be no adverse health effects on the public from the implementation. If IEPA concurs with a plan, the agency may provide temporary variances from some environmental regulations to enable the company to implement the plan.

The final component of the TPPA is the establishment of a Toxic Pollution Prevention Fund. Created as a special fund in the state treasury, the Toxic Pollution Prevention Fund is to be used to carry out the purposes of the TPPA and is not to be used to pay for cleanup or related activities. No sources of revenue, other than what might be generated through educational and training courses, have been appropriated to this fund.

2.5.2 Regulatory Authority for Implementation of Legislation in Illinois

As observed in reviewing the TPPA and the SWMA, two branches within the state government infrastructure implement the legislation applicable to waste reduction: the Illinois Environmental Protection Agency and the Illinois Department of Energy and Natural Resources. The responsibilities of these regulatory authorities are described below.

2.5.2.1 *Illinois Environmental Protection Agency*

As seen in the TPPA, the Illinois Environmental Protection Agency (IEPA) plays a prominent role in implementing the Toxic Pollution Prevention Program. IEPA recently began operation of a new Office of Pollution Prevention, which will be

responsible for operating a Pollution Prevention Network (PPN). The PPN is intended to serve as a special communications system to help market pollution prevention (IEPA, 1989).

The Illinois Materials Exchange Service (IMES), managed by the Solid Waste Management Section of the Division of Land Pollution Control in IEPA, is a clearinghouse for a variety of industrial by-products. A new waste reduction service within IMES, entitled the Waste Minimization Intern Program, uses engineering interns to conduct waste audits for small generators of hazardous waste (Illinois Hazardous Waste Advisory Council, 1987). The intern program is based on three assumptions:

1. Illinois companies will pursue waste minimization in their own self interest given the option to do so.
2. Students can learn and increase their knowledge of waste minimization through practical experience gained by working on it in industry.
3. The Illinois environment and public health of the citizens of the state will significantly benefit from voluntary waste minimization efforts in the industrial sector (IEPA, 1989).

In addition to the duties of the Office of Pollution Prevention, IEPA also serves as the regulatory enforcement agency in Illinois in charge of enforcing most federal regulations and all state regulations concerning pollution control. Under the authority granted by the Environmental Protection Act and subsequent amendments, IEPA has developed and implemented over the past several years a sweeping hazardous waste control program. This program includes a permit system for hazardous waste facilities; surveillance/compliance activities including routine inspections, groundwater monitoring, waste sampling, and a manifest system; in-house laboratory services; an emergency response staff; and an ongoing enforcement program (IEPA, 1985).

2.5.2.2 *Illinois Department of Energy and Natural Resources*

There are two divisions within the Illinois Department of Energy and Natural Resources (ENR) that promote waste reduction within the state. The first, the Office of Solid Waste and Resource Recovery, concentrates its efforts on solid waste and post-consumer waste. The second, HWRIC, focuses primarily on industrial waste reduction.

Established in 1984 within ENR, HWRIC's mission is to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities to help solve the hazardous waste

problems within the state (Kraybill, et al., 1989). Waste reduction has been a major focus of HWRIC's efforts to solve these hazardous waste problems. Even when it was created, the enabling legislation directed HWRIC to support waste reduction through research and educational programs conducted to foster the exchange of waste reduction information. According to Kraybill, et al. (1989), HWRIC's waste reduction activities include

- providing technical assistance to industries to help them eliminate the production of hazardous waste and improve their waste management;
- developing an interactive computerized waste management tool, the Multi-Option Model (MOM), to increase generators' knowledge of the wide range of options for reducing, recycling, and treating industrial waste;
- sponsoring an annual matching fund program for recycling and reduction technologies (RRT); and
- encouraging waste reduction/minimization through presentation of an annual Governor's Innovative Waste Reduction Award.

In addition, HWRIC and IEPA have received a RCRA Integrated Training and Technical Assistance (RITTA) grant to expand these activities. HWRIC has developed a waste reduction training program and provided technical support to IEPA's Waste Minimization Intern Program. The Governor's Innovative Waste Reduction Award has generated substantial interest in the industrial community, and HWRIC has received a number of waste reduction plans and program descriptions from industry and other groups. HWRIC has also worked with several industries on their waste reduction programs through the Technical Assistance Program.

Two local agencies, under contract to HWRIC, are conducting pilot projects to document waste reduction successes from technical assistance activities. These agencies are the Center for Neighborhood Technology in Chicago and Community Contacts, Inc. in Kane County. HWRIC is also conducting research on some innovative waste reduction technologies under a Waste Reduction Innovation Technology Evaluation (WRITE) contract from USEPA. The purpose of this contract is to quantify the reduction in the amount and toxicity of waste generated by various waste reduction technologies.

REFERENCES

- Arbuckle, J. Gordon and Timothy A Vanderver, Jr. 1985. "Water Pollution Control." In *Environmental Law Handbook*. Rockville, MD: Government Institutes, Inc.
- Auditor General, State of Illinois. 1989. *Management Audit of the Illinois Environmental Protection Agency's Hazardous Waste Program*. Springfield, IL: Office of the Auditor General.
- Congressional Budget Office. 1985. *Hazardous Waste Management: Recent Changes and Policy Alternatives*. Washington, DC: Congressional Budget Office.
- The Council of State Governments. 1989. *State Options for Reducing Hazardous Wastes*. Lexington, KY: The Council of State Governments.
- Environmental Defense Fund. 1986. *Approaches to Source Reduction of Hazardous Waste: Practical Guidance from Existing Policies and Programs*. Claremont, CA: California Institute of Public Affairs.
- Frick, William G. and Lydia N. Wegman. 1985. "Air Pollution Control." In *Environmental Law Handbook*. Rockville, MD: Government Institutes, Inc.
- Fund for Renewable Energy and the Environment. 1987. *The State of the State*. Washington, DC: Fund for Renewable Energy and the Environment.
- Hall, Ridgeway M. Jr. and Nancy S. Bryson. 1985. "Resource Conservation and Recovery Act." In *Environmental Law Handbook*. Rockville, MD: Government Institutes, Inc.
- Heavisides, Thomas K., Richard LaScala, K. R. Reddy, Timothy J. Warren, and Walter Zyzniwski. 1983. *Hazardous Waste in Illinois: An Overview*. Springfield, IL: Illinois Department of Energy and Natural Resources.
- Houghton, Mary J. 1987. *The Clean Water Act: AMENDMENTS OF 1987*. Rockville, MD: Bureau of National Affairs, Inc.
- Illinois Environmental Protection Agency. 1989. *Capacity Assurance Plan*. Springfield, IL: Illinois Environmental Protection Agency.
- Illinois Environmental Protection Agency. 1985. *RCRA Final Authorization: Program Description*. Springfield, IL: Illinois Environmental Protection Agency.
- Illinois Hazardous Waste Advisory Council. 1987. *Annual Report to Governor James R. Thompson and the 85th General Assembly*. Springfield, IL: Illinois Environmental Protection Agency.
- Kraybill, D.D., S. Mehta, and D. Thomas. 1989. "Waste Reduction Case Histories: What's Worked, What Hasn't, and Why." *Proceedings of the Second Annual Hazardous Materials Conference/Central*, March 14-16.
- Miller, Jeffrey G. 1985. "Safe Drinking Water Act." In *Environmental Law Handbook*. Rockville, MD: Government Institutes, Inc.

REFERENCES (CONTINUED)

- National Governors' Association. 1988. *Controlling Toxic Pollution: A Profile of State Activities*. Washington, DC: National Governors' Association.
- New Jersey Department of Environmental Protection. 1989. *Hazardous Substance Pollution Prevention: The Key to a New Era of Environmental Protection*. Trenton, NJ: New Jersey Department of Environmental Protection.
- Office of Technology Assessment. 1986. *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency*. Congress of the United States, Office of Technology Assessment, Washington, DC.
- Research Triangle Institute. 1989. *Programs to Promote Low- and Non-Waste Technology: Country Profile of the United States of America*. Washington, DC: U.S. Environmental Protection Agency.
- Schector, Roger N. 1987. "Reduction of Hazardous Wastes: Innovative Opportunities for Industry and Government." Paper Presented at the Waste Minimization Conference, Government Institutes, Inc., Washington, DC, February 19-20.
- U.S. Environmental Protection Agency. 1989. "WRITE Pilot Program with State and Local Governments." Manual presented at the WRITE workshop, Waste Minimization Branch, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, March 7-8.
- U.S. Environmental Protection Agency. 1988. *The Waste System*. Washington, DC: Office of Solid Waste and Emergency Response.

CHAPTER 3

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CHAPTER 3

DATA ON WASTE REDUCTION

3.1 OVERVIEW

Data on waste reduction activities at industrial facilities enable Illinois policymakers to evaluate the current status of waste reduction in Illinois and to highlight the need for further government and nongovernment programs to encourage waste reduction. Waste reduction data can be used to

- increase understanding of waste generating activities and the potential for waste reductions;
- identify factors that influence the success of waste reduction techniques;
- identify facilities that have implemented waste reduction and those that would benefit from more assistance;
- identify the types of waste reduction technologies that have been implemented for particular types of wastes; and
- plan for future waste management capacity.

This chapter describes current waste reduction activities in Illinois and evaluates sources of data on waste reduction. Section 3.2 describes different indicators of waste reduction progress and the advantages and disadvantages of these indicators. Section 3.3 lists specific types of data that are necessary to evaluate waste reduction activities. Section 3.4 evaluates the usefulness of particular data sources for assessing waste reduction. Based on this discussion, we draw conclusions about needs for additional data on waste reduction in Illinois. Finally, Section 3.5 discusses current waste generation and waste reduction activities in Illinois.

Throughout this chapter, we use the term “waste” to describe releases to the environment. Although this term is sometimes used to refer to solid wastes only, in this report the term is used to indicate releases of all types of waste to any environmental medium. Similarly, the term “waste reduction” refers to multimedia reductions in the quantity or toxicity of wastes generated by industrial facilities.

3.2 EVALUATING PROGRESS AT WASTE REDUCTION

Before analyzing current waste reduction activities in Illinois, we need a method of assessing waste reduction progress. This section describes measures of waste reduction and the shortcomings of those measures. For a more detailed discussion, see Baker and Warren (1989) and Hazardous Waste Research and Information Center (HWRIC, 1989).

This section examines three types of indicators of waste reduction progress. First, we discuss descriptive indicators, which show whether progress has been achieved but do not quantify the progress. Next we discuss measures of the quantity of waste reduced. Finally, we describe quantitative measures of the change in the level of hazard of the waste generated.

3.2.1 Descriptive Measures of Waste Reduction Progress

Descriptive measures of waste reduction progress indicate whether progress has been achieved, but do not quantify the degree of progress achieved. In descriptive terms, a facility may have made progress in waste reduction if any of the following conditions are true:

- Facility has established a waste reduction program.
- Facility initiated a waste reduction project during the reporting year.
- Facility initiated a waste reduction project during the reporting year and the quantity of waste generated by the facility decreased from the previous year.
- Facility initiated a waste reduction project during the reporting year and the adjusted quantity of waste generated decreased from the previous year. (The adjusted quantity is the quantity of waste generated adjusted for changes in production activity over the time period.)
- Facility initiated a waste reduction project during the reporting year and the level of hazard of the waste generated decreased.

The first two conditions listed assume that waste reduction progress has been made if a facility implemented a waste reduction program or activity. For each of the other conditions listed above, a facility must also demonstrate that the project has achieved some success at reducing releases of wastes to the environment. The measures of success used are reductions in the quantity of waste generated (either absolute or

adjusted) and the degree of hazard of wastes generated. Methods of determining each of these measures of progress are discussed in Sections 3.2.2 and 3.2.3.

3.2.2 Measures of the Quantity of Waste Reduced

Quantitative measures are used to assess the degree of progress achieved at waste reduction. The desired measure for assessing the quantity of waste reduced is the quantity of waste that was not generated because waste reduction activities were implemented. This quantity can be difficult to measure and can easily be misrepresented without precise methods to calculate it. Therefore, comparing changes in the amount of waste generated from one year to the next has been the focus of measuring waste reduction. In general, this information is available for most wastes released.

Two methods are used to measure the quantity of waste reduced. The actual method (ACT) measures the change in the quantity of waste generated from year to year. The adjusted method (ADJ) adjusts the actual quantity of waste generated to account for changes in the production or business activity that resulted in the generation of the waste, and then measures the change in this adjusted quantity of waste from year to year. We discuss the advantages and disadvantages of each of these measures below.

3.2.2.1 Actual (ACT) Method

The actual change in the quantity generated is the most direct of the two methods. The advantages of this method are that it is straightforward, easy to understand, and relatively simple to calculate. The only data required are the quantity of waste generated annually. A shortcoming of the ACT method is that it considers any decrease in waste generation to be waste reduction. Waste generation may decrease because of declining business or production activity (e.g., labor stoppage, plant shutdown, or shrinking market for a product) or some other change in operating conditions unrelated to a waste reduction program.

To illustrate the importance of this shortcoming, suppose that a facility experienced some growth in its production level from 1987 to 1988, which also resulted in an increase in the actual amount of waste generated in those same years. If the increase in the actual quantity of waste was less than the increase in production, then the facility actually generated less waste *per unit of production* in 1988 than in 1987. Consequently, the business made some progress in reducing its waste in adjusted terms

even though its actual quantity of waste increased. This progress is not revealed in the actual change in waste generation.

The actual change in the quantity generated is useful for a variety of applications. For example, this measure can aid in planning for hazardous waste treatment capacity. Nevertheless, the ACT method does not accurately represent the degree of progress achieved due to waste reduction activities.

3.2.2.2 *Adjusted (ADJ) Method*

The adjusted change in waste generation distinguishes changes in waste generation due to waste reduction activities from changes due to production, service, or other business activities. The ADJ method involves adjusting the actual change in the quantity of waste generated to account for changes in the level of business activity over the time period. The adjustment factor used is an activity/production index (activity index). An activity index is a measure of the change in the level of business activity and can be in the form of a ratio or a percentage change, as shown in the example below.

$$\text{Activity Index} = \frac{\text{number of cars produced during the reporting year}}{\text{number of cars produced during the prior year}} \quad (1)$$

The ADJ is calculated as follows:

$$\text{ADJ} = \text{tons of waste generated during reporting year} - (\text{tons of waste generated during prior year} \times \text{activity index}) \quad (2)$$

A negative number for ADJ indicates that the adjusted quantity of waste generated decreased during the reporting year (i.e., that progress at waste reduction occurred).

To be effective, an activity index must be calculated to accurately reflect changes in the level of the activity that generated the waste. Large distortions in the adjusted change in waste generation can occur if the activity index is incorrect. The following example illustrates this point:

A facility generated a constant flow of wastewater from its cooling systems while the plant was operational. The facility began production in August 1985 and was operational all year in 1986. The quantity of wastewater generated increased roughly 40 percent from 1985 to 1986. This is the same percentage change as the hours the plant was operational. If the change in output had been used as the measure of production, the adjusted measure of waste reduction would indicate that a large amount of waste reduction had occurred. Waste

generation increased only 40 percent, but production increased 400 percent! By looking at the change in the hours of operation, however, we see that no waste reduction occurred for this waste.

This example may appear to be an extreme case, but such large distortions in the measure of waste reduction can occur whenever the activity index is not related to the waste-generating activity.

A disadvantage of the adjusted method for measuring the quantity of waste reduced is that the activity index may be difficult to calculate for certain types of waste. Problems facilities have in reporting the activity index include (1) defining an appropriate measure of the level of activity, and (2) calculating the activity level. Both these problems are discussed below.

As illustrated in the example above, the activity index must be calculated to reflect changes in the waste-generating activity. For some types of wastes, defining an appropriate measure of the level of activity is difficult. The following examples from the USEPA National Survey of Hazardous Waste Generators illustrate this problem:

- (1) One chemical facility had a single waste stream that combined noncontact cooling water, storm water runoff, and sanitary sewage wastewater with wastewater from all production processes at the plant. The wastewater varied by the amount of rainfall (for storm runoff), the number of hours the plant was operational (cooling water), the amount of production activity, and the number of times an employee took a shower (sanitary sewage). Incorporating all these factors in a single activity index was not feasible. If the plant's wastewater was segregated and metered at its source, identifying an appropriate measure of activity level for each waste stream might be possible; however, this may be burdensome on the generator.
- (2) Another facility generated a spent acid from dip rinsing. The chemicals in the rinse expire with time and have to be changed periodically regardless of the level of output. In addition, for very large increases in output, the chemicals may have to be changed more frequently than is required due to expiration. Thus, the quantity of this waste generated is not directly related to changes in output, nor is it constant as long as the plant is operational.

Problems such as these can occur whenever a waste is generated from several production processes or the quantity of waste generated is not related to output at all.

For some wastes, defining an appropriate measure of activity for the activity index is possible, but actually measuring the activity level is not feasible. The following example taken from the USEPA National Survey of Hazardous Waste Generators illustrates this problem:

A wastewater is generated from cleaning and coating steel wire. An appropriate index for such an activity is the change in the total surface area coated. However, the surface area coated varies constantly. Wire of all different sizes may be run on a given day, even at the same time. Measuring the total surface area of wire coated is not feasible.

Other cases where calculating the level of activity is difficult include wastes from multi-product processes and aggregated wastes from many different waste-generating activities. Installing extensive waste tracking equipment or other monitoring equipment may permit facilities to calculate an activity index for many of these wastes, but the amount of resources facilities would have to devote to such a system may detract from the resources available for waste reduction activities.

One final problem with the adjusted method is that it contains the implicit assumption that all changes in waste generation are due to either waste reduction activities or to changes reflected in the activity index. A variety of changes in operating conditions not reflected in the activity index may also affect the quantity of waste generated. Examples of such changes include

- raw material quality,
- weather conditions,
- throughput rates, and
- worker productivity.

Isolating the effect of operating conditions and other factors on the quantity of waste generated requires very detailed data on many factors and would be burdensome on the regulated community.

Despite these shortcomings, because the adjusted measure of waste reduction adjusts for changes in the level of business activity, it is generally more accurate than the actual measure. Whenever feasible, the adjusted measure should be used. In cases such as those described in this section where reporting an accurate activity index is not feasible, the actual measure could be used.

3.2.3 Measures of Changes in the Level of Hazard

Changes in the level of hazard of a waste are not reflected in actual or adjusted changes in the quantity generated. Currently, no method exists to easily and economically assess changes in all factors affecting the level of hazard of a waste. The number of factors would have to enter into such a calculation makes developing such a

methodology infeasible at the present time. Factors that would have to be considered include

- toxicity, ignitability, corrosivity, and reactivity of the waste;
- location of release;
- environmental medium of release;
- extent of human or environmental exposure to the waste; and
- rate at which waste decomposes or dissipates.

Current data sources do collect limited information on changes in the level of hazard. The USEPA National Survey of Hazardous Waste Generators includes qualitative data on how waste reduction activities affected the toxicity of waste generated (increased toxicity, decreased toxicity, or no change), but do not require quantitative measurements. Similarly, data on the quantity of chemical constituents released are reported annually in the USEPA Toxic Chemical Release Inventory (TRI), but no other information on the level of hazard is reported.

Models could be developed to assess the effect of changes in the generation of wastes on the risk posed to human health. Such a model should consider such factors as the toxicity of a waste, the quantity released, the means of release, the dispersion rate of the waste in the environment, and the population affected by the release. Developing such a model for releases of all chemicals through all possible means would be costly. In addition, the data which would be required from facilities may be burdensome. Finally, such a model does not incorporate the effects of factors other than toxicity—such as ignitability, corrosivity, or reactivity—that affect the level of hazard.

The Degree of Hazard (DOH) ranking system developed by the Illinois Department of Energy and Natural Resources provides an alternative method for incorporating hazard considerations into a waste reduction measure. By considering a wide variety of factors, all of which contribute to the risk posed by a waste to human health and the environment, this ranking provides a sound scientific basis for classifying wastes according to their degree of hazard. The system places waste streams into “high,” “moderate,” “low,” or “negligible” hazard categories.

Even though the DOH system has important uses in waste reduction policy analyses, the DOH system is not as useful in actually *measuring* waste reduction. The DOH system places wastes into categories of hazard rather than quantifying the level of hazard. Consequently, if the amount of waste in the “high” category falls while the

amount in the “moderate” category increases, there is no way to determine the total extent of waste reduction in total (including hazard considerations).

If a measure of the total amount of waste reduction in the state is not needed, the DOH system could be used to monitor changes in the quantity of waste generated in each individual category. For example, changes in the generation of “high” hazard wastes could be monitored separately from changes in “moderate” hazard wastes and “low” hazard wastes. However, a comprehensive hazard index for measuring the total change in the level of hazard does not exist at the current time, and such an index would be costly to develop and implement.

An alternative to measuring the total change in the level of hazard is to assess changes in the individual factors that contribute to the level of hazard for each waste. Data on the toxicity, ignitability, corrosivity, and reactivity of a waste reported annually by facilities could be used to assess changes in these factors over time. Although no algorithm exists to assess the net effect of changes in several factors, monitoring all these factors gives a more complete and accurate description of the effects of waste reduction.

3.2.4 Recommendations for Evaluating Waste Reduction Progress

When available, the adjusted change in the quantity of waste is the most accurate measure of progress at waste reduction. The advantage of this measure is that it distinguishes changes in waste generation due to waste reduction from changes due to production or other business activity. The disadvantage is that factors other than waste reduction and economic activity that affect the quantity of waste generated (or reported) are not considered in the adjusted measure of waste reduction. Also, some facilities are unable to report the activity/production information necessary to adjust the quantity generated.

No single measure of waste reduction progress is appropriate and accurate for all facilities and all wastes: waste-generating activities and waste reduction opportunities vary too greatly and too many factors affect the quantity generated. One alternative is to analyze several measures of waste reduction progress. Earlier in this chapter we described descriptive and quantitative indicators of waste reduction progress that can be used in combination for analyses. For example, if the actual quantity generated of a particular waste decreased, the adjusted quantity generated decreased, the concentration of the waste decreased, and the waste underwent a waste reduction activity, one could

conclude that progress in waste reduction had been made. Examining a variety of indicators provides a more complete and accurate picture of waste reduction. Therefore, the use of multiple indicators is the best approach to assessing progress in waste reduction.

3.3 DATA NEEDED FOR EVALUATING WASTE REDUCTION

Detailed data on waste reduction activities at facilities as well as descriptive information about the facility, its waste generating processes, and the types and quantities of waste generated are necessary to evaluate waste reduction progress. The specific conclusions that can be drawn from waste reduction data depend on the types of data collected. This section describes the data needed to assess waste reduction progress described.

Any assessment of waste reduction progress should be multimedia in scope. That is, data should include releases to all environmental media: air, water, and land. Monitoring only one environmental medium may falsely suggest a reduction in waste generation, even though the waste may have been simply transferred to another medium. Such waste transfers are not waste reduction activities and may not represent a reduction in the risk to human health or the environment. Multimedia monitoring is necessary to encourage the reduction in releases to all environmental media.

Conducting a longitudinal study to collect data on waste generation and waste reduction activities for consecutive years is necessary to fully characterize waste reduction activities. Assessing progress in waste reduction, requires observing changes over time rather than making a static assessment of waste reduction activities at one point in time.

A second reason for a longitudinal study of waste reduction is that all the positive effects of a waste reduction activity may not be observed in the year the activity is implemented. A data collection effort covering just one year's worth of data may underestimate the amount of progress achieved. Tracing the effects of an activity over several years will provide a more complete description of the results of waste reduction.

A third reason for a longitudinal study of waste reduction is that it allows an analysis of a single facility's progress over time. For a one-time study, progress must be judged by comparing one facility to another or comparing all facilities to some standard.

Caution must be exercised in making such comparisons, because facilities have operational differences that affect the quantity of waste they generate and the level of waste reduction they can feasibly achieve. Such differences include the age of production equipment, product quality, customer specifications, and raw materials available.

To assess waste reduction, data should be gathered that can be used to

- identify and characterize the generating facility,
- describe the generating facility's waste reduction program,
- identify and characterize each waste generated,
- describe the waste reduction activities implemented for each waste, and
- measure the degree of progress at waste reduction achieved for each waste.

Table 3-1 lists examples of data that provide the types of information listed above.

The first data category listed in Table 3-1 is "Facility Identification." This information helps characterize the types of facilities showing progress in waste reduction. Information on a facility's waste reduction program, the second category of Table 3-1, can be used to characterize the nature and scope of each waste reduction program. Types of data listed in this category include information on the sources of technological information and financing for waste reduction activities, and information on the reasons for implementing waste reduction. All these types of data are useful for evaluating the efficacy of government and nongovernment programs in promoting waste reduction effectiveness.

The remaining categories of Table 3-1 describe waste-specific data (i.e., data that are reported separately for each waste generated at a facility). As with the facility identification data, the waste identification data can be used to characterize the types of waste that are most amenable to waste reduction. When combined with data in the next category, data on waste reduction activities implemented, the waste identification information can be used to identify which waste reduction activities are most effective for particular types of waste streams. The last category of Table 3-1 lists data that can be used to assess the degree of progress achieved at waste reduction. Section 3.2 of this chapter describes how to use these data to measure waste reduction progress.

Table 3-1. Types of Data Needed to Evaluate Waste Reduction**Facility Identification**

- SIC (industry) code
- Size of facility (e.g., number of employees, revenues, total quantity of waste generated)
- Facility name and identification number

Facility Waste Reduction Program

- Nature of program (e.g., written policy, employee training, routine audits, waste reduction goals)
- Length of time program has been in place
- Sources of technical information and financial assistance
- Reasons for implementing waste reduction, and reasons preventing further implementation of waste reduction activities

Waste Identification

- RCRA waste code, if applicable
- Waste description code
- Waste-generating process description
- Recurrent / nonrecurrent waste
- Primary / secondary waste
- Physical form of waste
- Waste management methods
- Waste composition

Waste Reduction Activities

- Waste reduction activities implemented for each waste

Waste Reduction Progress Achieved

- Quantity of waste generated and changes over time
- Production or activity index (index of the change in the level of business activity for the waste-generating process(es))
- Indicators of the level of hazard (toxicity, acidity, reactivity, ignitability)
- Total quantity of waste recycled (on site and off site)
- Quantity of new recycling (on site and off site)

The following section evaluates existing data sources on waste generation in Illinois. We evaluated these data sources based on the data needs described in this section.

3.4 DATA SOURCES FOR EVALUATING WASTE REDUCTION IN ILLINOIS

Both the USEPA and the IEPA collect data on releases of industrial wastes to the environment. In this section, we evaluate the usefulness of these current data collection efforts for evaluating waste reduction progress. We use the data needs discussed in Section 3.3 of this report as criteria for evaluating the data sources. Table 3-2 summarizes our evaluation of the data sources for each of these criteria.

Data collection in Illinois is based on the regulatory framework established through a combination of federal and state statutes and regulations. Understanding that framework helps us identify the limitations and strengths of these data for assessing waste reduction. Many of the limitations of the data sources discussed in this section can be attributed to the fact that most of these data were not collected to assess waste reduction.

In general, the current regulatory framework emphasizes regulating releases to the environment. Regulations ensure that specific wastes are managed and released in a manner that minimizes the risk to human health and the environment. Therefore, much of the data gathered contain information on the waste management methods used and the amount of waste released, rather than on the amount of waste generated. Information on waste generation is required to measure reductions in the quantity of wastes generated, or waste reduction progress.

Current regulations are, in general, organized based on the environmental medium to which a waste is released. The data gathered to support these regulations are also organized on a media-specific basis. For example, data on discharges to water are collected under the federal Clean Water Act, while data on air quality are collected as required by the federal Clean Air Act. As explained in Section 3.3, multimedia data are needed to assess waste reduction. The only data source discussed in this section that covers releases to all media is the Toxic Chemical Release Inventory (TRI), authorized under the Superfund Amendments and Reauthorization Act of 1986 (SARA).

Table 3-2. Comparison of Data Sources on Waste Reduction in Illinois

<i>Data Source</i>	Facility Identification	Facility Waste Reduction Program	Waste Identification	Waste-Specific Waste Reduction Activities	Measures of Progress	Wastes Covered	Years Covered
<i>IEPA Generator Annual Report</i>	Location	May include in waste minimization statement	Narrative description; RCRA code	Narrative description in waste minimization statement	None	RCRA hazardous wastes shipped off site	Annual
<i>IEPA Facility Annual Report</i>	Location	May include in waste minimization statement	Narrative description; RCRA code; handling method	Narrative description in waste minimization statement	Quantity generated may be reported for wastes generated on site	RCRA hazardous wastes treated on site	Annual
<i>IEPA On-site Industrial Waste Handling Report Form</i>	Location; principal industrial activity	None	Narrative description; handling method	None	None	Wastes handled in surface impoundments, land spreading, landfill, or waste pile on site	Every 3 years
<i>IEPA Special Waste Stream Application & Special Waste Manifest</i>	Location	Certification that program is in place	Process description; RCRA code; treatment/process waste; handling methods	None	None	Industrial solid wastes from process or pollution control processes or RCRA hazardous	Application filed for new wastes or change in TSD; manifest filed for each shipment
<i>USEPA National Survey of Hazardous Waste Generators</i>	Location; SIC code; number of employees	Components of program; audit; sources of information; reasons for implementing; effect on other media	RCRA code; waste description code; waste source code; SIC code; handling methods on site and off site	Activities implemented prior to or during 1986 for each waste	Quantity generated, 1985 & 1986; change in production; quantity recycled, 1986; change in toxicity	RCRA hazardous wastes; wastes hazardous under federal or state laws	1986 only

continued

Table 3-2. Comparison of Data Sources on Waste Reduction in Illinois (Continued)

<i>Data Source</i>	Facility Identification	Facility Waste Reduction Program	Waste Identification	Waste-Specific Waste Reduction Activities	Measures of Progress	Wastes Covered	Years Covered
<i>USEPA National Survey of Hazardous Waste TSDR Facilities</i>	Location; SIC code; number of employees	None	RCRA code	None	Quantity generated in 1986	Wastes hazardous under federal or state laws	1986 only
<i>USEPA Toxic Chemical Release Inventory (TRI)</i>	Location; SIC code	None	CAS number	Activities implemented for each chemical (<i>optional</i>)	Quantity generated (<i>optional</i>)	All listed toxic chemicals manufactured, processed, or otherwise used on site	Annual
<i>Ambient Air Quality Data</i>	None	None	None	None	Quantity of specific pollutants in the air	Releases to air of particulates, SO _x , NO _x , ozone, and lead	Air quality is monitored several times annually
<i>National Emissions Data System (NEDS)</i>	Location; SIC code	None	Waste-generating process; pollution control devices; operating rate	None	None	Stack air emissions of particulates, SO _x , NO _x , VOC, CO	Annual
<i>Permit Compliance System (PCS)</i>	Location; SIC code	None	Varies by permit requirements; may include volume, flow, toxicity, temperature, etc.	None	None	Releases to water from point sources by facilities with NPDES permits	Varies by permit; usually, data reported quarterly or monthly

Table 3-3 lists the data sources discussed in this section by the environmental medium the data cover. Releases from manufacturing and nonmanufacturing facilities are listed separately to illustrate that TRI covers releases from manufacturing facilities only. The data sources listed in Table 3-3 may not contain complete information on the releases indicated. The remainder of this section describes the types of information for evaluating waste reduction that are contained in each data source. Data sources discussed below are organized by the environmental medium for which they maintain data. TRI, a multimedia data source, is discussed first.

3.4.1 Multimedia Data Source (USEPA Toxic Chemical Release Inventory)

Title III of SARA requires facilities in manufacturing industries (Standard Industrial Classification (SIC) codes 20 to 39) to file a Toxic Chemical Release Inventory (TRI) annually. Covered facilities must submit a report for each toxic chemical that is manufactured, processed, or otherwise used on site in regulated amounts. Data reported include general facility information and chemical-specific information identifying each toxic chemical, its uses at the facility, waste management methods, and the quantity released.

An important difference between TRI and many of the other data sources described in this section is that data contained in TRI are for specific chemicals, not individual wastes. For example, if a toxic chemical (e.g., benzene) is released in a water-based solution, only the quantity of the toxic chemical (benzene) released is reported. The quantity of water is not reported. Because the total quantity of waste released is not reported, the TRI data may not be as useful as waste-specific data for planning treatment and disposal capacity needs. Also, comparing TRI data with waste-specific data from other data sources is difficult because no data on the types of materials released with a toxic chemical are reported in TRI.

The major advantage of TRI for evaluating waste reduction is that it is multimedia in scope. That is, data are reported on the release of toxic chemicals to all environmental media. Multimedia reporting prevents the misinterpretation of transfers of waste from one media to another as waste reduction activities. A second advantage is that TRI contains much of the information needed to characterize the type of facility and the type of release.

Table 3-3. Data Sources on Wastes by the Environmental Media of Release

Type of Release	Data Source ^{a,b}
Air	
■ Fugitive Emissions	
• manufacturing facilities	• TRI
• nonmanufacturing facilities	• <i>None</i>
■ Stack Emissions	
• manufacturing facilities	• TRI, NEDS
• nonmanufacturing facilities	• NEDS
Water	
■ Point Sources	
• manufacturing facilities	• TRI, PCS
• nonmanufacturing facilities	• PCS
■ Nonpoint Sources	
• manufacturing facilities	• TRI
• nonmanufacturing facilities	• <i>None</i>
Land	
■ Hazardous Special Wastes Managed On Site	
• manufacturing facilities	• TRI, GENS, Facility Annual Report
• nonmanufacturing facilities	• GENS, Facility Annual Report
■ Hazardous Special Wastes Managed Off Site	
• manufacturing facilities	• TRI, GENS, Facility Annual Report, SWM
• nonmanufacturing facilities	• GENS, Facility Annual Report, SWM
■ Nonhazardous Special Wastes Managed On Site	
• manufacturing facilities	• On-Site Industrial Waste Handling Report
• nonmanufacturing facilities	• On-Site Industrial Waste Handling Report
■ Nonhazardous Special Wastes Managed Off Site	
• manufacturing facilities	• SWM
• nonmanufacturing facilities	• SWM
■ Nonspecial Wastes	• <i>None</i>

^aAbbreviations used:

TRI = Toxic Chemical Release Inventory
 NEDS = National Emissions Data System
 PCS = Permit Compliance System

SWM = Special Waste Manifest
 GENS = National Survey of Hazardous Waste Generators

^bData sources listed may not contain complete information for the releases indicated. Consult text for description of types of data included.

Although TRI does cover releases to all environmental media, it does not cover all releases of industrial waste in Illinois. Figure 3-1 summarizes the criteria for including data in TRI. Only releases greater than the threshold quantities are reported. For 1987, the most recent year for which data are available, facilities that manufactured, imported, or processed over 75,000 pounds of a listed chemical were required to file a TRI report. Only releases from manufacturing facilities (SIC codes 20-39) are reported. In addition, TRI covers releases of listed toxic chemicals only. Nontoxic wastes and wastes not on the TRI list are not included.

TRI contains information on the waste reduction activities facilities have implemented for each toxic chemical they generated. Data on waste reduction include the quantity of each chemical generated as waste during the reporting and the prior year and the change in business activity during that time period. Reporting this information is optional. In 1987, only 11 percent of all chemical-specific TRI forms received nationwide included any of this optional information. Illinois firms reported waste reduction data for approximately 50 chemical-specific releases, representing approximately 1.5 percent of the releases reported in Illinois. This information is not sufficient to evaluate waste reduction progress throughout the state.

3.4.2 Data Sources on Solid Wastes

The term “solid waste” is defined by USEPA to include discarded solid, liquid, semi-solid, and contained gaseous materials. Solid waste does not include domestic sewage, wastewater released from point sources and subject to permits under the federal Clean Water Act, and radioactive waste regulated under the federal Atomic Energy Act. In Illinois, all solid wastes generated through industrial or pollution control processes or considered hazardous under the Resource Conservation and Recovery Act (RCRA) are termed “special wastes.” Figure 3-2 diagrams these classifications. Regulatory and data reporting requirements for special wastes depend on the quantity generated, whether the waste is classified as hazardous, and the methods used to manage the waste. Data sources on solid wastes and their usefulness for evaluating waste reduction are discussed below.

3.4.2.1 IEPA Generator Annual Hazardous Waste Report

The IEPA gathers data on hazardous wastes generated in Illinois and shipped off site for further handling. Hazardous special wastes are those wastes that are considered hazardous under the federal RCRA. Data are reported annually by Large Quantity

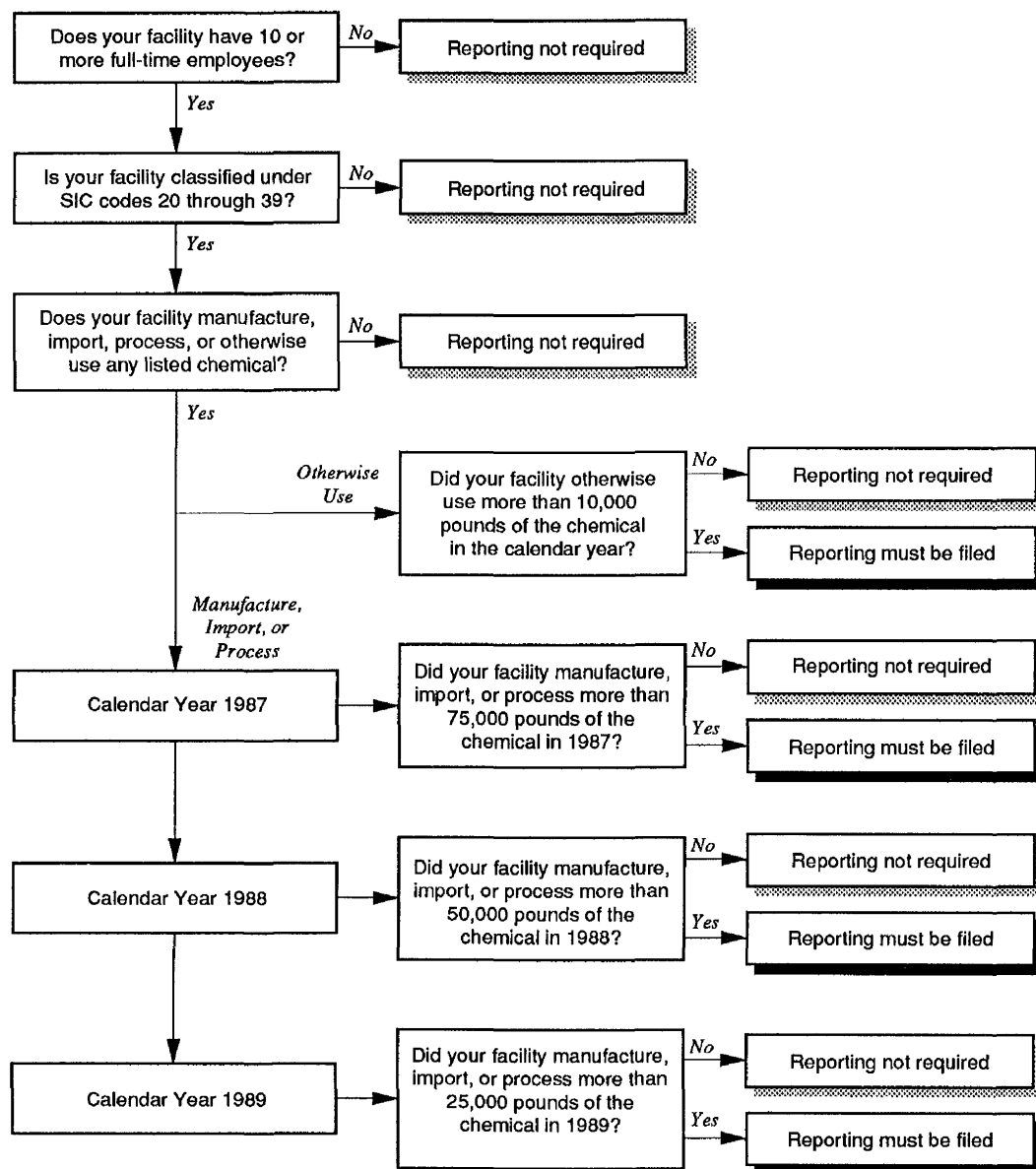


Figure 3-1. Criteria for including data in Toxic Chemical Release Inventory.

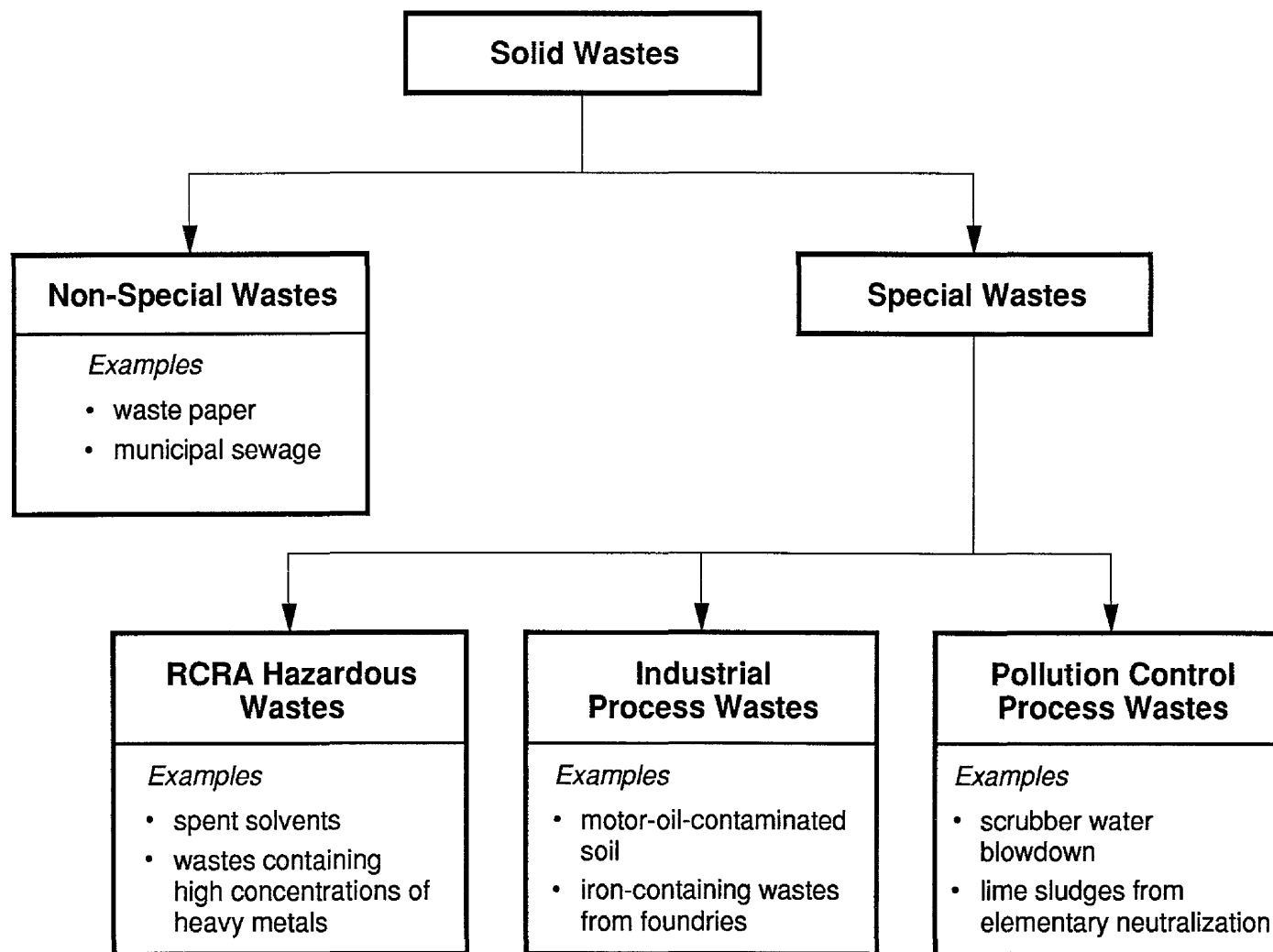


Figure 3-2. Classification of solid wastes in Illinois.

Generators (LQGs) of hazardous wastes that shipped regulated quantities of hazardous waste off site during the reporting period. LQGs generate more than 1,000 kg of hazardous waste (or 1 kg of acutely hazardous waste) in any single month or accumulate on site more than 1,000 kg of hazardous waste (or 1 kg acutely hazardous waste) at any time during the year.

The IEPA Generator Annual Report contains the following types of data for evaluating waste reduction (see Section 3.3 for a description of data types):

- generating facility identification and characterization,
- waste characterization, and
- description of waste reduction activities.

The waste reduction information is reported in narrative form in the “waste minimization statement” section of the report. This information is difficult to analyze because it is not in a standard format. No instructions are provided on how to calculate and report changes in volume or toxicity of waste. Also, it is difficult to link information provided in the waste minimization statement to the individual wastes described in other sections of the report. Such a link would provide both descriptive information about the wastes that were reduced and some indication of the amounts of waste reduction.

To assess progress at waste reduction, Illinois needs data on the amount of all wastes generated by a facility. The IEPA Generator Annual Report does not meet this requirement on two points. First, only the quantity of waste shipped off site is reported. There is no indication of whether this is the total quantity generated or whether the waste underwent some treatment prior to shipping, whereby only the residual after treatment would be reported. Second, the IEPA Generator Annual Report does not cover all wastes generated. Only RCRA hazardous wastes are reported. Third, there is no record of whether hazardous wastes generated underwent treatment or disposal at the site where the wastes are generated. Finally, recyclable materials specifically listed in 35 Illinois Administrative Code 721.106(a)(3) are not reported. These materials include used oil, batteries, and other hazardous wastes recycled according to the specifications of this section.

Information on the level of production or business activity for the processes that generated hazardous wastes is necessary to adjust actual changes in waste generation for changes in the business activity that generated the waste. The IEPA Generator Annual Report does not include any information on levels of business activity.

3.4.2.2 IEPA Hazardous Waste Treatment, Storage, and Disposal Facility Annual Report

Facilities which treat, store, or dispose of RCRA hazardous wastes are required to complete the IEPA Treatment, Storage, and Disposal (TSD) Facility Annual Report. The report identifies the generator of all wastes handled by each TSD facility during the reporting year, the type and quantity of waste handled, and the handling method applied. If a waste remains in storage on site at the end of the reporting year, the amount stored is reported.

Waste reduction information in the IEPA Facility Annual Report is similar to that in the IEPA Generator Annual Report. Facilities are required to include a waste minimization statement in the comments section of the report. Because there is no standardized reporting method, the information from this statement is difficult to analyze. Facilities are not instructed on evaluating and reporting the progress they achieved at waste reduction. Finally, it may be difficult to link information provided in this section to individual wastes listed in the IEPA Facility Annual Report. Such a link would provide both descriptive information about the waste which underwent waste reduction and some indication of the amount of the waste.

As with the IEPA Generator Annual Report, the IEPA Facility Annual Report contains no information on the level of business activity for waste-generating processes. This information is necessary to adjust the change in the quantity of waste for changes in business activity over the time period.

To prevent interpreting a transfer of waste from one media to another any assessment of waste reduction progress should cover all releases of waste to the environment. The IEPA Facility Annual Report contains data on RCRA hazardous wastes undergoing treatment, storage, or disposal in Illinois only. Thus it does not meet this criterion.

To evaluate the amount of waste reduction achieved, the quantity of each waste generated annually must be reported. For wastes handled at the site where they are generated, the IEPA Facility Report may contain data on the amount of waste generated. Facilities are required to report the amount of each of these wastes, but the reporting form contains no explicit directions indicating at what point in the waste management process the quantity of waste is to be reported. Quantities reported after treatment may distort any assessment of waste reduction progress. For waste that was received from off site for

handling, the generator reports no information on the quantity of waste it actually generated. Facilities report only the quantity of waste received from off site.

IEPA has combined data from the IEPA Generator Annual Report and from the IEPA Facility Annual Report in an effort to quantify the total amount of waste generated in Illinois. The total quantity of waste generated is the total quantity treated in Illinois, plus the amount shipped out of state, minus the amount generated out of state and treated in Illinois, and minus the amount that had been in storage at the end of the previous reporting year. Although this method may provide a reasonable estimate of the total amount of waste generated in Illinois, it is less useful on a waste-specific level. Making waste-specific assessments requires linking wastes from the IEPA Facility and Generator Annual Reports and attempting to ascertain how much of each waste was generated. This is not feasible because of the number of wastes generated and inconsistencies in reporting. Thus the IEPA Annual Reports do not currently provide the data needed to evaluate waste reduction progress adequately.

3.4.2.3 IEPA On-Site Industrial Waste Handling Report Form

IEPA began collecting data for the On-Site Industrial Waste Handling Report in 1988. Data will be collected every three years. Facilities report data on special wastes treated in surface impoundments or in land treatment, and on nonhazardous wastes landfilled or stored in a wastepile longer than one year.

For each covered waste handling operation on site, facilities report the type of operation, the types of waste treated in that operation, the amount treated annually, and the remaining capacity. Neither waste reduction information nor the quantity of waste generated are not reported. Both of these data sources are needed to evaluate waste reduction progress.

3.4.2.4 IEPA Special Waste Stream Application and Special Waste Manifest

The IEPA Special Waste Stream Application and Special Waste Manifest must be filed for each special waste shipped off site by generators of over 100 kg per month of special waste. The two documents are used to ensure that the special wastes generated in Illinois undergo treatment and disposal in a manner that minimizes the risk to human health and the environment.

Prior to the treatment, storage, or disposal of a new special waste, facilities are required to file a Special Waste Stream Application with the IEPA. The application

contains general information on the facility that will handle the waste and on the facility that generated the waste to be handled. Information on the characteristics of the waste, the proposed handling methods, and the ultimate disposition of the waste and any residuals must also be reported. No information on waste reduction activities is reported.

The IEPA Special Waste Stream Application contains information that would be very useful in characterizing the waste stream, including information on the processes that generated the waste and an indication as to whether the waste is generated through production activities or through pollution control activities. But because no data on the quantity of waste generated or on waste reduction activities are reported, the application can not be used to assess waste reduction progress.

The IEPA Special Waste Manifest is used to track transfers of special waste in Illinois. The manifest identifies the generator, transporter(s), and the facility receiving the shipment. A manifest must accompany each shipment of special waste generated by generators of over 100 kg per month of special waste. Data describing the type and the quantity of each special waste shipped are included in the manifest. As with the IEPA Special Waste Stream Application, however, no data on the quantity of waste generated or on waste reduction activities are reported. Also, the manifest includes only data on special wastes shipped off site. No data are collected on wastes managed at the generating facility. Thus the manifest data cannot be used to evaluate waste reduction progress.

3.4.2.5 USEPA National Survey of Hazardous Waste Generators

The USEPA's National Survey of Hazardous Waste Generators (Generator Survey) was conducted under RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA). A survey population of approximately 41,000 hazardous waste generators was established based on information from the 1985 Biennial Reports, and a one-stage, state-level, stratified sample of 10,400 facilities was selected for the Generator Survey. Strata are defined by the state in which a facility is located and the quantity of hazardous waste a facility generated in 1985.

Surveys were mailed to a sample of 361 Illinois generators of hazardous waste. The list of facilities from which the sample was drawn was provided by merging several sources: the Regional RCRA permitting databases, the Biennial Report Data, and personal contacts by the Survey Team to each state permitting agency. The primary

source was the 1985 Biennial Report list of generators provided by the IEPA to the USEPA. Of the facilities surveyed, 251 facilities, or approximately 70 percent, were large quantity generators (LQG) of hazardous waste. The response rate for Illinois was about 92 percent of those selected for the survey—about the same as the national response rate.

The Generator Survey contains data on generators' hazardous waste generation and management activities in 1986. The survey includes facility-specific data on waste reduction programs as well as waste-specific data on waste reduction activities implemented for each hazardous waste generated. The survey also contains the facility and waste identification data described in Table 3-1. This information can be used to analyze the types of wastes and facilities undergoing waste reduction and those that require additional assistance.

One important advantage of the Generator Survey in evaluating waste reduction is that data are reported for wastes at the point they are generated. In the IEPA reports, in comparison, the quantity of waste after treatment may be reported rather than the quantity of waste generated prior to treatment. Information on the quantity generated is needed to assess waste reduction, the reduction in the quantity or toxicity of waste generated due to changes in the waste-generating processes or procedures.

The Generator Survey can be used to assess the degree of progress achieved through waste reduction activities. For each hazardous waste generated, the survey has information on the quantity of waste generated in 1985 and in 1986 and the change in production activity during the same time period. These data can be used to calculate the quantity of waste reduction achieved. The calculation of this quantity is described in Section 3.2 of this report. The Generator Survey also contains two other types of information useful for assessing waste reduction: the quantity of each hazardous waste recycled and the change in the toxicity of each hazardous waste due to waste reduction activities.

There are some important disadvantages of the Generator Survey for assessing waste reduction progress. First, because it was a one-time survey, the Generator Survey does not provide the longitudinal data necessary to trace progress over time. Also, the survey is not multimedia—it covers only wastes considered hazardous under RCRA or under state laws.

3.4.2.6 *USEPA National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities*

The USEPA National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling (TSDR) Facilities was implemented in conjunction with the Generator Survey. All active RCRA-permitted TSDR facilities identified were surveyed, including approximately 108 facilities in Illinois. In addition to general facility information, each TSDR facility provided detailed information on each hazardous waste management operation on site.

The TSDR Survey does not include any information on waste reduction activities. Facilities did report the type and the quantity of each waste generated on site in 1986 but not for any subsequent or preceding years. Thus the TSDR survey can not be used for assessing progress at waste reduction. Nevertheless, each facility in the TSDR Survey also completed the Generator Survey. Data on progress at waste reduction by TSDR facilities is contained in the Generator Survey.

3.4.3 Data Sources on Releases to Air

IEPA collects two types of data on air emissions: ambient air quality data and point source emissions data. In addition, data on air emissions is collected as part of TRI. TRI data are described in Section 3.4.1.

3.4.3.1 *Ambient Air Quality Data*

Ambient air quality data provide information on the level of pollution in the surrounding air for a given area (IEPA, 1989b). Air quality data are not associated with a particular source of pollutants, but rather the overall level of pollution in an area. These data include releases of wastes from industrial sources and nonindustrial sources such as car exhaust fumes. Air quality is monitored at over 200 sites throughout Illinois. Data are collected on the concentrations of a variety of pollutants in the air including

- particulate matter,
- sulfur dioxide,
- carbon monoxide,
- ozone,
- nitrogen dioxide, and
- lead.

Monitoring ambient air quality is a useful means for assessing changes in the quantity of pollutants released to the environment. But there are several important disadvantages of ambient air quality data that preclude using it to assess progress in waste reduction. First, the data cover releases to only one environmental medium, and only a small number of air pollutants to the air are monitored. A second disadvantage is that the quantity of waste generated is not monitored. This information is necessary to differentiate changes in the quantity of release due to waste reduction from changes due to treatment activities. A third disadvantage is that the information covers the air quality for an area. Decreases in pollution cannot feasibly be associated with a particular facility. Finally, the air quality data contain no information about waste reduction activities.

3.4.3.2 *National Emissions Data System*

Point source emissions data are maintained in the National Emissions Data System (NEDS). Point sources are stationary sources of air pollution that release 100 tons or more annually of any criteria pollutant. Actual air emissions levels are not reported by facilities for NEDS. USEPA calculates the amount of waste released based on emissions rates, which it defines for each process generating a criteria pollutant. A facility's emission levels in NEDS are based on this emissions rate and the process operating rate and pollution control equipment as reported by the facility in its permit. Data are updated whenever a permit is renewed. In Illinois, permits are renewed every two years on average but can be issued for up to five years. Facilities must report to the permit office any new pollution control equipment, but need not report any other changes resulting in reductions in the amount of waste generated.

The NEDS point source data cannot be used to assess progress at waste reduction. If a facility implemented a waste reduction activity that reduced the emission rate for a point source, this reduction would not be reflected in the USEPA-defined emission rate used in the NEDS database. Also, NEDS contains no information on waste reduction activities. Finally, the data are not multimedia and only cover five pollutants released to the air.

3.4.4 *Data Sources on Releases to Water (Permit Compliance System)*

The Permit Compliance System (PCS) tracks permit compliance and monitoring information for the National Pollutant Discharge Elimination System (NPDES). The

database maintains release information for facilities discharging pollutants into the waters of the United States from point sources (i.e., discharge pipes). The collection of these data is authorized by the federal Clean Water Act and its amendments.

The PCS database includes industrial, federal, and municipal dischargers. Each of these broad categories has been further subdivided into major and minor dischargers. For municipal dischargers, or Publicly Owned Treatment Works (POTW), this distinction is based on the quantity of effluent discharged: major facilities release more than 1 million gallons per day. For all other facilities this distinction is based on a rating system that considers the following criteria:

- volume of effluent released,
- industry,
- location of facility, and
- body of water into which the facility discharges.

Complete data on major facilities are stored in PCS.

While the PCS provides valuable pollution information, its purpose is to monitor the release of wastewater. The PCS provides very little, if any, of the waste generation, waste reduction, or recycling information necessary to assess waste reduction progress. In addition, PCS does not cover all environmental releases. Only data on major discharges to water from point sources are included. Discharges to water from nonpoint sources such as runoff are not included.

While comparing the quantities of wastewater released over time is valuable, because of its shortcomings PCS does not provide a way to detect whether any changes are a result of waste reduction activities.

EPA maintains databases containing a wide variety of information on water quality. Other than PCS, these databases do not attribute the generation of a waste to a particular source. Therefore they are not helpful in assessing progress in waste reduction by facilities. They do, however, provide valuable information to regulators and may aid in assessing progress in a geographic area.

3.4.5 Summary of Data Sources

While a great deal of data have been and are being collected on releases to the environment in Illinois, these data have limited use for assessing waste reduction progress. In general, the major disadvantages of existing data are as follows:

- not multimedia,
- monitor changes in the quantity of waste released rather than generated, and
- do not have data on waste reduction.

TRI is the only multimedia data source on releases. As such, TRI is an important regulatory tool but has limited uses for assessing waste reduction because very little waste reduction data are reported.

The air-specific and water-specific data sources discussed above contain no information on waste reduction or on the quantity of waste generated before treatment. Also, they cover a limited number of releases to a single environmental medium.

The IEPA Generator and Facility Annual Reports also are not multimedia in scope. The reports monitor treatment, storage, and disposal (TSD) activity, not waste generation. It is not feasible to use the waste reduction information included in these data sources for most analyses. The narrative format makes processing the data costly.

The USEPA Generator Survey is currently the only source of data on waste reduction activities. Both facility- and waste-specific waste reduction data are reported in a standardized format for all wastes generated. This data source is not multimedia in scope, however, and only includes data for 1986.

Additional data are needed to accurately evaluate waste reduction activities in Illinois. Options within the existing regulatory structure include standardizing waste reduction information reported in the Facility and Generator Annual Reports and requiring facilities to report changes in the quantity of waste generated, and requiring facilities to report waste reduction data in the TRI. Proposed legislation introduced in the U.S. Congress would mandate reporting waste reduction data in TRI (i.e., S. 585 "The Pollution Prevention Act of 1989" discussed in Section 2.3.2.1). The advantage of the TRI option is that it would provide multimedia data, although it would not cover all industries.

3.5 WASTE GENERATION AND WASTE REDUCTION IN ILLINOIS

Despite data limitations, current data sources can be used to characterize releases of wastes to the environment in Illinois. In this section, we summarize available data on waste generation and waste reduction in Illinois.

3.5.1 Waste Generation and Releases to the Environment

Evaluating waste reduction progress requires data on the quantity of all wastes generated before treatment. These data are not available in Illinois because

- no single data source covers all releases—many releases are not included in any data source; and
- most of the data sources include information on the quantity of waste released or shipped off site, not the quantity generated—only the National Survey of Hazardous Waste Generators has data on the quantity of waste generated before treatment.

The Toxic Chemical Release Inventory (TRI) is the only data source that covers releases to all environmental media. TRI data are discussed first. Next, data on releases of special wastes in Illinois are discussed. Data limitations are briefly discussed here; for a more complete description of data sources, see Section 3.4.

3.5.1.1 Data on Multimedia Releases

TRI is the most complete source of data on releases to the environment. It is the only data source covering releases to all environmental media. Nevertheless, the data have several limitations:

- includes only manufacturing facilities (SIC codes 20-39),
- includes releases of only about 300 toxic chemicals, and
- requires reporting of data on the quantity of a toxic chemical released only; reporting data on the quantity generated is optional and was reported for less than 1.5 percent of releases in Illinois in 1987.

The total quantity of toxic chemicals released in Illinois in 1987 and reported in TRI is approximately 439 million pounds. Figure 3-3 shows the breakdown of these releases by the environmental medium of the release. Fugitive air, stack air, water, underground, and land refer to releases to each of these environmental media on site. POTW refers to all shipments of wastewater to Publicly Owned Treatment Works. All other off-site transfers of waste for further handling are included in the category “Off-Site.”

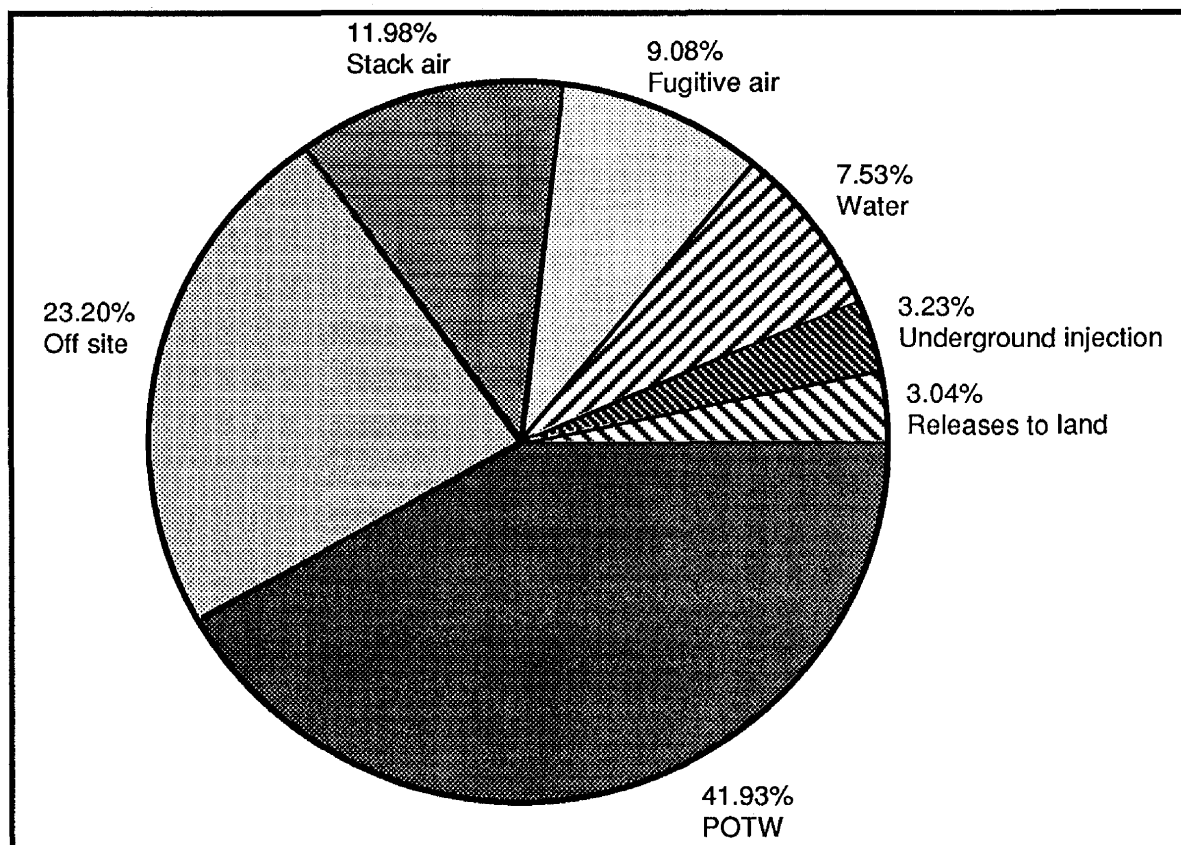


Figure 3-3. Releases of toxic chemicals by manufacturing facilities in 1987 (in pounds). Total quantity of toxic chemicals released in Illinois by manufacturing facilities in 1987 = 439,883,487 pounds. Only those facilities with SIC codes 20-39 that used over 10,000 pounds of a listed toxic chemical or manufactured or processed over 75,000 pounds of a listed toxic chemical are included. Source: IEPA (1989).

Table 3-4 lists the industries in Illinois that released the greatest quantities of toxic chemicals in 1987, as reported in TRI. The 15 industries listed account for approximately 75 percent of all releases reported in Illinois (by quantity).

3.5.1.2 Data on Special Wastes

Special wastes are defined as solid wastes that are

- generated by industrial processes,
- generated by pollution control processes, or
- considered hazardous under RCRA.

Table 3-4. Top 15 Industries Releasing the Largest Quantities of Toxic Chemicals in 1987

SIC Code	Industry	Quantity Released (pounds)
2865	Cyclic crudes, and cyclic intermediates, dyes, and organic pigments	69,325,442
2821	Plastics materials, synthetic resins, and nonvulcanizable elastomers	38,140,956
2046	Wet corn milling	30,285,987
3341	Secondary smelting and refining of nonferrous metals	29,570,762
3079	Miscellaneous plastics products	27,771,330
2819	Industrial inorganic chemicals, not elsewhere classified	25,330,494
2899	Chemicals and chemical preparations, not elsewhere classified	22,824,199
2816	Inorganic pigments	20,324,422
2869	Industrial organic chemicals, not elsewhere classified	18,723,191
3312	Blast furnaces, steel works, and rolling mills	15,183,658
2911	Petroleum refining	9,326,479
3714	Motor vehicle parts and accessories	7,866,258
2843	Surface active agents, finishing agents, sulfonated oils and assistants	6,601,058
2851	Paints, varnishes, lacquers, enamels, and allied products	6,598,468
2752	Set-up paperboard boxes	5,690,481

Note: Quantities cover releases to all environmental media. Facilities included are only those facilities with SIC codes 20-39 that used over 10,000 pounds of a listed toxic chemical or manufactured or processed over 75,000 pounds of a listed toxic chemical.

Source: IEPA (1989a).

Data on special wastes are maintained in several data sources:

- National Survey of Hazardous Waste Generators (Generator Survey)
- National Survey of Treatment, Storage, Disposal, and Recycling Facilities (TSDR Survey)
- IEPA Hazardous Waste Treatment, Storage, and Disposal Facility Annual Report
- IEPA Generator Annual Report
- IEPA Special Waste Stream Application
- IEPA Special Waste Manifests

Figure 3-4 summarizes the quantities of special wastes reported in each data source in 1986. The figure also shows the types of special wastes included in each data source. Data from the Facility Annual Report and the Generator Annual Report and data from Special Waste Stream Applications and Special Waste Manifests are combined to provide more complete data. The combined data are identified in the figure by the reports that summarize the data: "Summary of Annual Reports" and "Composition of Nonhazardous Special Waste Streams."

Differences in the quantities reported in each data source in Figure 3-4 are due to differences in

- the quality of the data reported,
- the completeness of the data reported,
- who reported the data (i.e., the generator or the treatment, storage, and disposal facility), or
- the point at which the quantity is measured (i.e., before or after treatment).

Only the Generator Survey and the TSDR Survey contain data on the quantity of waste generated before treatment.

In addition to the differences described above, there is a large difference in the quantity of hazardous special waste reported in the Generator Survey and the quantity reported in the TSDR Survey. The TSDR Survey does not contain complete data on hazardous wastes managed in units exempt from RCRA permitting requirements. The TSDR Survey only contains data on hazardous special wastes for facilities that managed wastes both in RCRA-permitted units and units exempt from RCRA permitting requirements. The TSDR Survey only has these data for facilities which also managed wastes in permitted units. This is because, in general, only facilities with RCRA permits

DATA SOURCE	Hazardous Special Wastes Shipped Off Site	Hazardous Special Wastes Managed On Site	Hazardous Wastes Managed in Units Exempt from RCRA Permitting Requirements	Nonhazardous Special Wastes Shipped Off Site
A. 1986 National Survey of Treatment, Storage, Disposal and Recycling Facilities	Source A 559,177 tons	Source A 14,059,184 tons		
	Source A 18,551,072 tons generated			
B. 1986 National Survey of Hazardous Waste Generators	Source B 26,155,255 tons generated			
C. Summary of Annual Reports on Hazardous Waste for 1984 through 1987 (IEPA, 1988)	Source C 582,585 tons	Source C 1,885,775 tons		
D. "Composition of Non-Hazardous Special Waste Streams Generated by Manufacturing Facilities" (Perry, 1989)	Source D 487,778 tons			Source D 3,176,479 tons

Figure 3-4. Quantity of special wastes reported by data source. Boxes not extending completely into a column indicate that data source does not cover all the special wastes indicated in that column. Conversion factors used: 202 gallons/cubic yard, 240 gallons/ton, and 2,000 pounds/ton. All quantities are 1986 data.

were included in the survey. This difference has been indicated in Figure 3-4 by extending the box showing the quantity reported in the TSDR Survey only half-way into the column for wastes managed in exempt units.

Figure 3-4 also shows a large difference in the quantity of hazardous special wastes managed on site reported in the TSDR Survey and the quantity reported in the IEPA Annual Reports. One reason for this discrepancy is that quantities in the TSDR Survey are reported prior to treatment while IEPA Annual Report data may be reported after treatment. The main reason for the discrepancy is that all hazardous wastes managed on site are not reported in the IEPA Annual Reports. In general, hazardous wastes discharged to water via a POTW or a NPDES permit are not reported in the IEPA Annual Reports. Both these types of hazardous waste are included in the TSDR Survey. In Figure 3-4, the box for the IEPA Annual Reports extends only part-way into the column for hazardous wastes managed on site to indicate that the IEPA Annual Reports do not cover all wastes in this category.

In addition to the data on the quantity of hazardous waste generated described in Figure 3-4, the Generator Survey contains information that characterizes the types of hazardous wastes generated and the waste-generating activities. Table 3-5 shows the top 25 hazardous waste-generating industries in Illinois in 1986, as reported in the Generator Survey. The quantity of hazardous waste generated by each industry in 1986 and each industry's percentage of the total quantity of hazardous waste generated in Illinois. Table 3-6 shows the waste-generating processes that generated the greatest quantities of hazardous waste in Illinois in 1986. Each waste-generating process describes an activity that was a source of hazardous waste reported in the Generator Survey.

No single data source in Illinois contains complete information on nonhazardous wastes. The Generator Survey covers only hazardous special waste. No data are reported on releases of nonhazardous special wastes or nonspecial wastes. Similarly, TRI does not have information on nontoxic releases. However, HWRIC has combined waste description data from Special Waste Stream Applications with waste quantity data from special waste manifests to describe releases of nonhazardous special wastes manifested in Illinois. The data are compiled in the report "Composition of Nonhazardous Special Waste Streams Generated by Illinois Manufacturers."

Table 3-5. Top 25 Industries Generating the Largest Quantities of Hazardous Waste in 1986

SIC Code	Industry	Number of Wastes	Quantity Manifested (tons)	Percentage	Cumulative Percentage
3315	Steel wire and related products	33	7,695,955	29.42	29.4
3482	Small arms ammunition	40	1,790,507	6.85	36.3
3351	Copper rolling and drawing	6	1,729,228	6.61	42.9
3398	Metal heat treating	24	1,729,228	6.61	49.5
3471	Plating and polishing	291	1,110,774	4.25	53.7
2819	Industrial inorganic chemicals, nec	50	740,531	2.83	56.6
2869	Industrial organic chemicals, nec	42	196,523	0.75	57.3
2821	Plastics materials and resins	112	193,341	0.74	58.1
2911	Petroleum refining	26	184,746	0.71	58.8
3632	Household refrigerators and freezers	17	147,644	0.56	59.3
3634	Electric housewares and fans	3	147,635	0.56	59.9
3429	Hardware, nec	47	145,666	0.56	60.5
3312	Blast furnaces and steel mills	21	83,823	0.32	60.8
2034	Dehydrated fruits and vegetables	5	65,839	0.25	61.0
3523	Farm machinery and equipment	9	43,938	0.17	61.2
4953	Refuse systems	29	43,437	0.17	61.4
8999	Miscellaneous services, nec	29	33,788	0.13	61.5
2851	Paints and allied products	130	30,149	0.12	61.6
3479	Metal coating and allied services	256	24,836	0.09	61.7
2892	Explosives	9	21,408	0.08	61.8
3714	Motor vehicle parts and accessories	87	20,867	0.08	61.9
3644	Noncurrent-carrying wiring devices	71	20,212	0.08	61.9
3679	Electronic components, nec	67	14,847	0.06	62.0
3451	Screw machine products	118	14,162	0.05	62.0
2899	Chemical preparations, nec	46	11,966	0.05	62.1
Total top 25 industries			16,241,050	62.1	62.1
Other industries			106,867	0.4	0.4
Total wastes unidentified ^a			9,807,338	37.5	37.5
Total all wastes			26,155,255	100.0	100.0

^aThe category "unidentified wastes" includes all wastes for which the SIC code was not reported.

Source: USEPA National Survey of Hazardous Waste Generators.

Table 3-6. Top 25 Waste-Generating Processes Generating the Largest Quantities of Hazardous Waste in 1986

Waste-Generating Process	Number of Wastes	Quantity Manifested (tons)	Percentage	Cumulative Percentage
Pickling	53	7,732,098	29.56	29.6
Wastewater treatment	78	5,777,595	22.09	51.7
Electroplating	271	1,090,373	4.17	55.8
Inorganic aqueous reactions	10	488,632	1.87	57.7
Other pollution control or waste treatment process	32	470,023	1.80	59.5
Spray rinsing	26	298,293	1.14	60.6
By-product processing	19	75,019	0.29	60.9
Surface coating (e.g., painting, electroless plating, phosphating)	228	61,204	0.23	61.1
Gas adsorption	3	59,581	0.23	61.4
Other process	114	44,199	0.17	61.5
Dewatering	3	33,195	0.13	61.7
Caustic (alkali) cleaning	64	33,165	0.13	61.8
Product rinsing	36	28,731	0.11	61.9
Other waste production process	149	25,713	0.10	62.0
Dip rinsing	140	17,347	0.07	62.1
Regenerating	2	10,407	0.04	62.1
Tank bottoms removal	47	9,507	0.04	62.1
Cleanup of spill residues	40	8,365	0.03	62.2
Clean out of process equipment	186	8,243	0.03	62.2
Reactions/synthesis media processing	8	7,764	0.03	62.2
Distillation and fractionation	7	7,406	0.03	62.3
Filtering/screening	5	7,105	0.03	62.3
Heavy ends/still bottoms removal	10	7,065	0.03	62.3
Polymerization	13	6,826	0.03	62.4
Flush rinsing	118	6,497	0.02	62.4
Total top 25 waste-generating processes	1,662	16,314,353	62.4	62.4
Other waste-generating processes		33,564	0.1	0.1
Total wastes unidentified ^a		9,807,338	37.5	37.9
Total all wastes	2,786	26,155,255	100.0	100.0

^aThe category "unidentified wastes" includes all wastes for which the waste-generating process was not reported.

Source: USEPA National Survey of Hazardous Waste Generators

The data on nonhazardous special wastes are not complete. The data cover only one year (1986) and include only nonhazardous special wastes generated by manufacturing facilities (SIC codes 20-39) meeting all of the following criteria:

- shipped the waste off site and file a special waste manifest;
- filed a special waste permit application and included data on the waste's components;
- reported the volume of waste shipped in the manifest (or the quantity was reported in units that could be converted to volume); and
- generated 100 kg per month or more of the waste.

Tables 3-7 and 3-8 summarize data available on nonhazardous special wastes. Table 3-7 describes the 100 largest nonhazardous special wastes by the quantity of waste manifested (i.e., shipped off site). These waste streams represent 96.5 percent (by quantity) of all nonhazardous special wastes meeting the above criteria. The wastes are grouped by their composition. The largest category is water and aqueous wastes. Table 3-8 shows the quantity of nonhazardous special wastes manifested by manufacturing industries in 1986. The Fabricated Metals industry (SIC code 34) generated over half of all nonhazardous waste manifested by manufacturing facilities.

3.5.2 Waste Reduction

Complete data on waste reduction for all wastes released to all environmental media are not available in Illinois at the present time. While TRI does cover releases to all media, waste reduction data are reported for only 50 releases in Illinois. Conversely, the Generator Survey contains very detailed waste reduction data, but covers only hazardous special wastes. Waste reduction data from both these sources are summarized below.

3.5.2.1 Toxic Chemical Release Inventory (TRI)

Reporting waste reduction information in TRI is optional. In 1987, complete waste reduction data were reported for less than 50 individual releases, representing approximately 1.5 percent of all releases reported in TRI. Also, TRI includes only data on releases of toxic chemicals by manufacturing facilities (SIC 20-39). For the releases reporting waste reduction in TRI, the actual quantity of waste generated decreased by 2,911,875 pounds, or 38.4 percent, from 1986 to 1987.

Table 3-7. Composition of the Top 100 Nonhazardous Special Wastes Generated by Manufacturing Facilities

Waste Composition Category	Number of Wastes	Quantity Manifested (tons)	Percentage	Cumulative Percentage
Water and aqueous wastes	4	688,835	46.8	46.8
Wastes containing metal	18	456,394	31.0	77.8
Waste containing sand, clay, dust, dirt or ash	16	126,831	8.6	86.4
Waste containing oil and grease	17	49,401	3.4	89.7
Other organic solids and sludges	24	40,665	2.8	92.5
Other inorganic solids and sludges	5	22,823	1.5	94.0
Waste containing lime and gypsum	8	19,520	1.3	95.4
Waste containing pulp and paper	3	10,396	0.7	96.1
Waste containing asbestos	2	1,376	0.1	96.2
Miscellaneous	3	4,597	0.3	96.5
Total top 100 nonhazardous special waste generated by manufacturing facilities	100	1,420,843	96.5	96.5
Total all Special Non-Hazardous Wastes Generated by Manufacturing Facilities	1,048	1,472,871	100	100

Notes: Table shows the composition of the 100 largest nonhazardous special wastestreams by the quantity manifested (i.e., shipped off site).
Manufacturing facilities include all facilities with 2-digit SIC codes 20 through 39.

Source: Perry (1989).

Table 3-8. Nonhazardous Special Wastes Generated, by Manufacturing Industry

SIC Major Group	Industry	Number of Facilities	Quantity Manifested (tons)	Percentage
34	Fabricated metal products	95	860,181	57
28	Chemical and allied products	100	176,547	12
35	Machinery, except electrical	61	134,444	9
33	Primary metal industries	35	102,890	7
37	Transportation equipment	15	102,520	7
20	Food and kindred products	47	35,944	2
29	Petroleum refining and related industries	20	28,526	2
36	Electrical and electronic machinery	39	18,079	1
32	Stone, clay, grass, concrete products	16	16,878	1
27	Printing, publishing, and allied industries	11	10,847	0.7
30	Rubber and miscellaneous plastic products	15	10,552	0.7
26	Paper and allied products	20	2,945	0.2
38	Measuring, analyzing, and controlling instruments	5	1,265	<0.1
39	Misc. manufacturing industries	9	942	<0.1
31	Leather and leather products	3	910	<0.1
25	Furniture and fixtures	2	193	<0.1
22	Textile mill products	1	49	<0.1
24	Lumber and wood products, except furniture	2	36	<0.1
Totals		496	1,503,331	100

Note: Only the quantity of waste manifested (i.e., shipped off site) is shown. Manufacturing industries are industries with 2-digit SIC codes 20 through 39.

Source: Perry (1989).

3.5.2.2 *National Survey of Hazardous Waste Generators (Generator Survey)*

The Generator Survey is the most complete source of information on waste reduction in Illinois. The Generator Survey's data limitations are (1) it covers only hazardous wastes and (2) it was a one-time survey.

The term "waste minimization" is used in the Generator Survey to describe waste reduction practices. Waste minimization is defined in the survey as the reduction of the hazardous waste generated or subsequently undergoing treatment, storage, or disposal. The definition includes reductions in (1) the total volume or quantity of waste or (2) the toxicity of waste. The two activities constituting waste minimization are source reduction (i.e., reductions in hazardous waste generation at its source) and recycling. The term "waste minimization" is used to describe the Generator Survey data.

Data on facility waste minimization practices and the percent of facilities that implemented each practice are shown in Figure 3-5. The figure shows that 72 percent of all facilities responding to the Generator Survey have a waste minimization program in place. While this appears to indicate that a great deal of waste minimization activity is taking place in Illinois, it is important to note that facilities have an incentive to report having a waste minimization program. First, having a waste minimization program can improve the public's opinion of a facility. Second, hazardous waste generators that manifest their waste (i.e., ship waste off site) are required by federal law to have a waste minimization program in place. Also, what constitutes a waste minimization program is not defined in the Generator Survey. Having a waste minimization program in place may not indicate that the facility is actively pursuing waste reduction. For a better indicator of this type of activity, see Figures 3-7 to 3-12.

The Generator Survey collected data on the reasons facilities implemented and did not implement waste minimization practices. This information can be used by policy analysts as an indicator of the types of programs that would encourage further waste reduction in Illinois. Figures 3-6 and 3-7 summarize this data. Figure 3-6 lists incentives that encourage facilities to institute waste minimization. The figure shows the percent of facilities that reported implementing, planning, or considering implementing waste minimization practices as a result of each incentive. Not all facilities responding to an incentive actually implemented a waste minimization practice. The most common incentive to waste minimization is the reduced waste management costs associated with generating less waste.

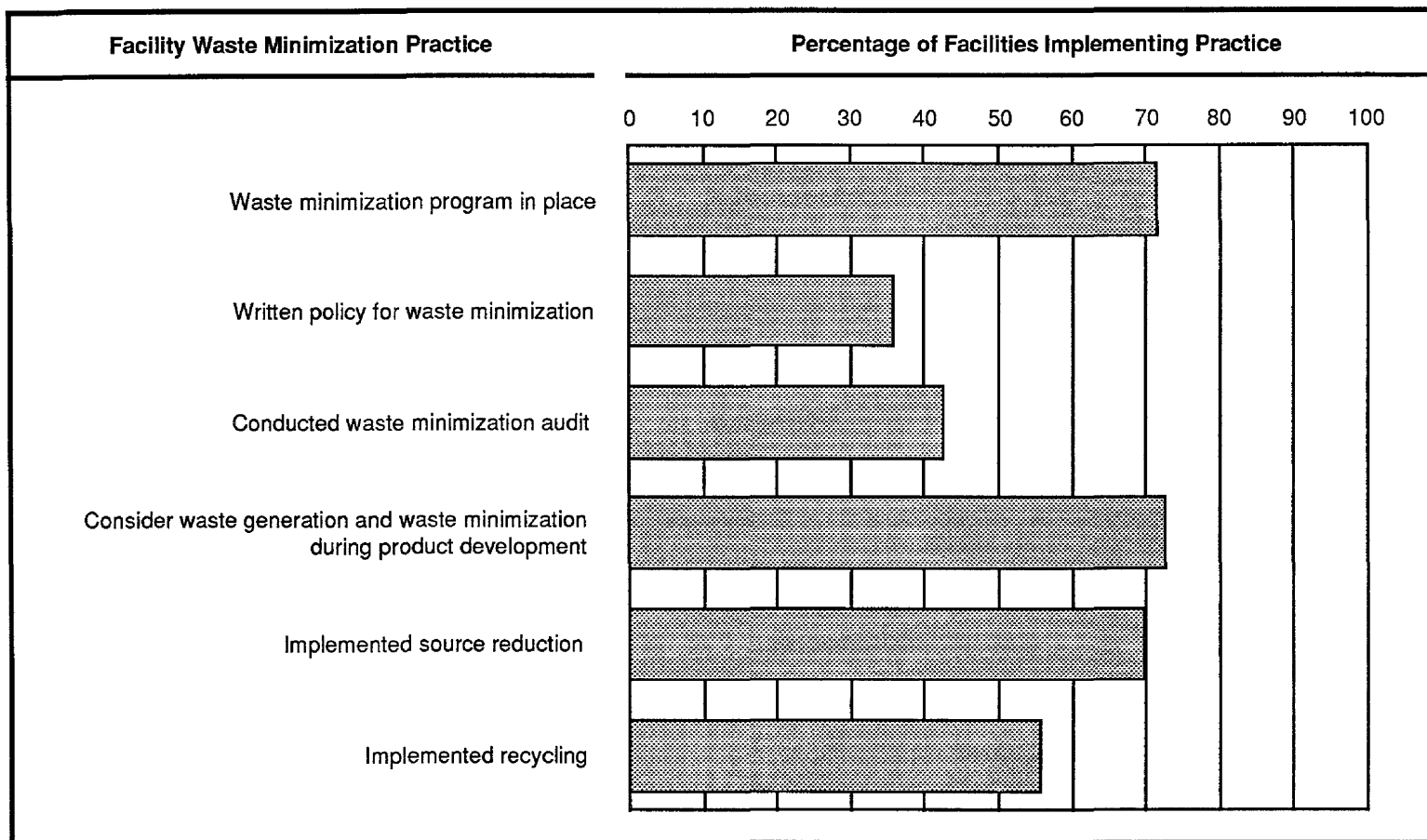


Figure 3-5. Facility waste minimization practices. Percentages represent the number of facilities that reported implementing the waste minimization practice indicated out of all Illinois facilities represented in the Generator Survey. Source: National Survey of Hazardous Waste Generators.

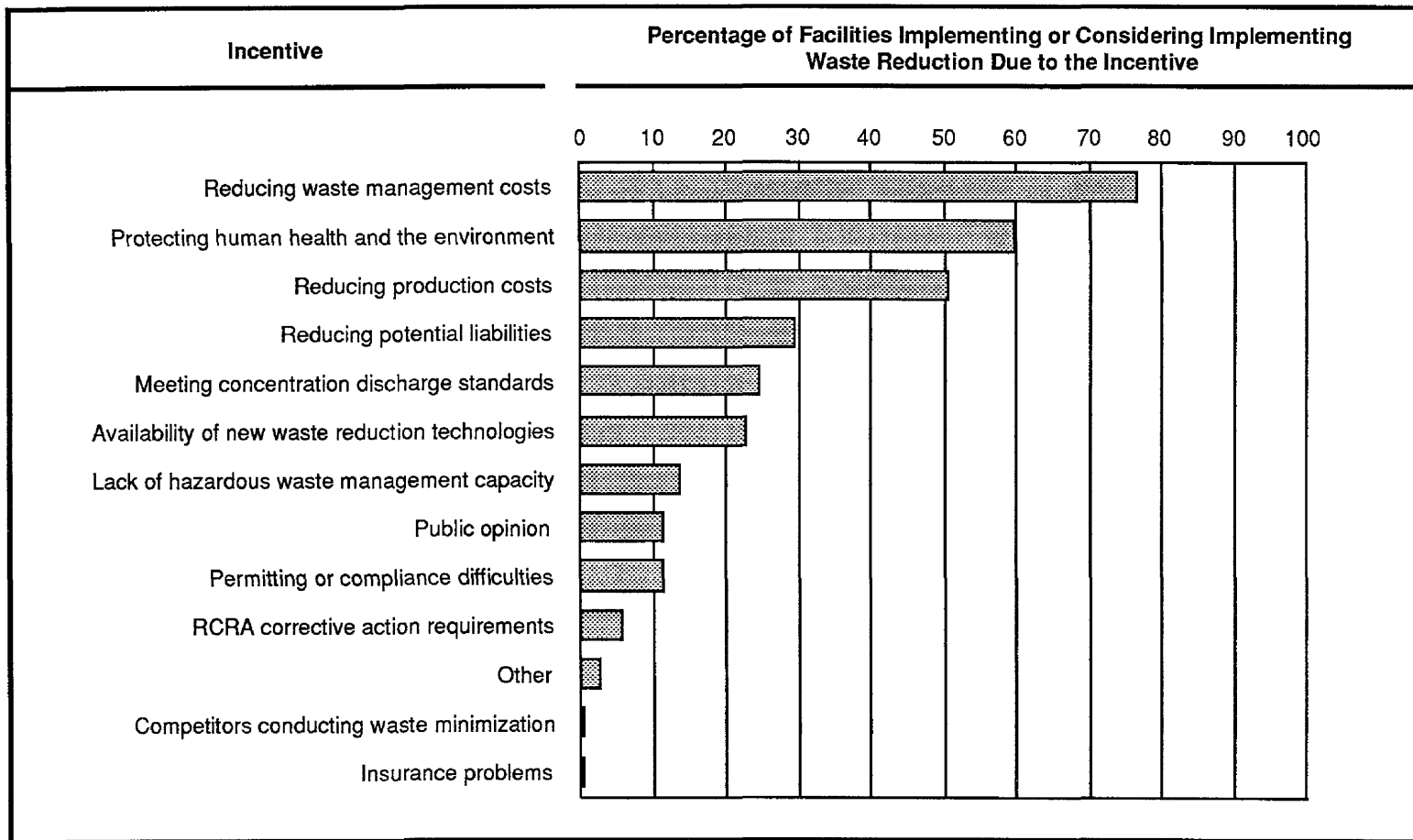


Figure 3-6. Incentives for implementing waste minimization. Responses to incentives include planning, considering, or implementing waste minimization practices. Facilities could indicate more than one incentive. Percentages represent the number of facilities responding to the indicated incentive out of all Illinois facilities represented in the Generator Survey. Source: National Survey of Hazardous Waste Generators.

Figure 3-7 summarizes the barriers that discourage facilities from implementing waste minimization. The figure shows, for each barrier, the percentage of facilities that reported not implementing waste minimization due to that barrier. The most common barrier to waste minimization is that the costs of instituting a waste minimization technique outweigh the potential savings.

In addition to the information on facility waste minimization programs described above, the Generator Survey contains data on the waste minimization techniques implemented for each hazardous waste generated. Figure 3-8 summarizes these data. The figure shows the percentage of all wastes generated in Illinois for which each waste minimization technique was implemented. Data are shown for techniques implemented both during and prior to 1986. The first category listed shows the percentage of all wastes for which any waste minimization technique was implemented. The figure shows that only 50 percent of all wastes underwent waste minimization prior to or during 1986.

Finally, the Generator Survey contains data that can be used to characterize the types of wastes that underwent waste minimization. These data can be used by policy analysts to identify the types of wastes or industries that are not implementing waste minimization and therefore may benefit from more information or assistance. Figures 3-9 to 3-12 show the percentage of wastes in different categories that underwent waste minimization. Wastes are categorized by

- industry,
- waste-generating process,
- RCRA waste code, and
- quantity generated in 1986.

For comparison, each figure includes the percentage of all wastes that underwent waste minimization.

Figure 3-9 categorizes wastes by industry. Only the top industries by the number of wastes generated are shown in the figure. Of those industries shown, Paints and Allied Products accounted for the greatest percentage of wastes undergoing waste minimization. Over 95 percent of the wastes in the Paint and Allied Products industry underwent waste minimization in 1986, compared to only 34 percent for all wastes. Of the industries included in the figure, all but the Plastics and Resins industry had more wastes undergo waste minimization than the total for all wastes.

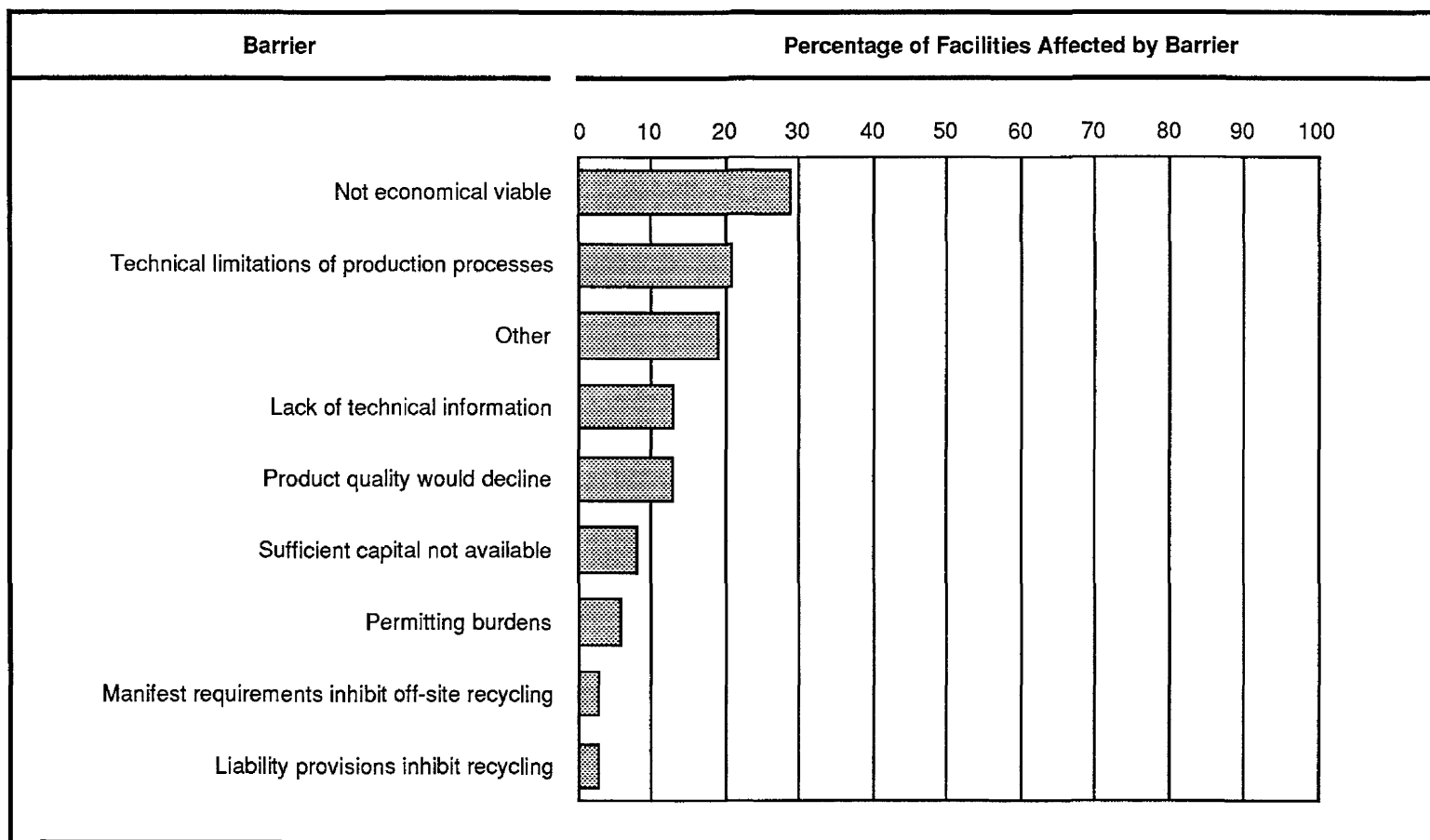


Figure 3-7. Barriers to implementing waste minimization. Facilities could indicate more than one barrier. Percentages represent the number of facilities that did not implement waste minimization because of the barrier indicated out of all Illinois facilities represented in the Generator Survey. Source: National Survey of Hazardous Waste Generators.

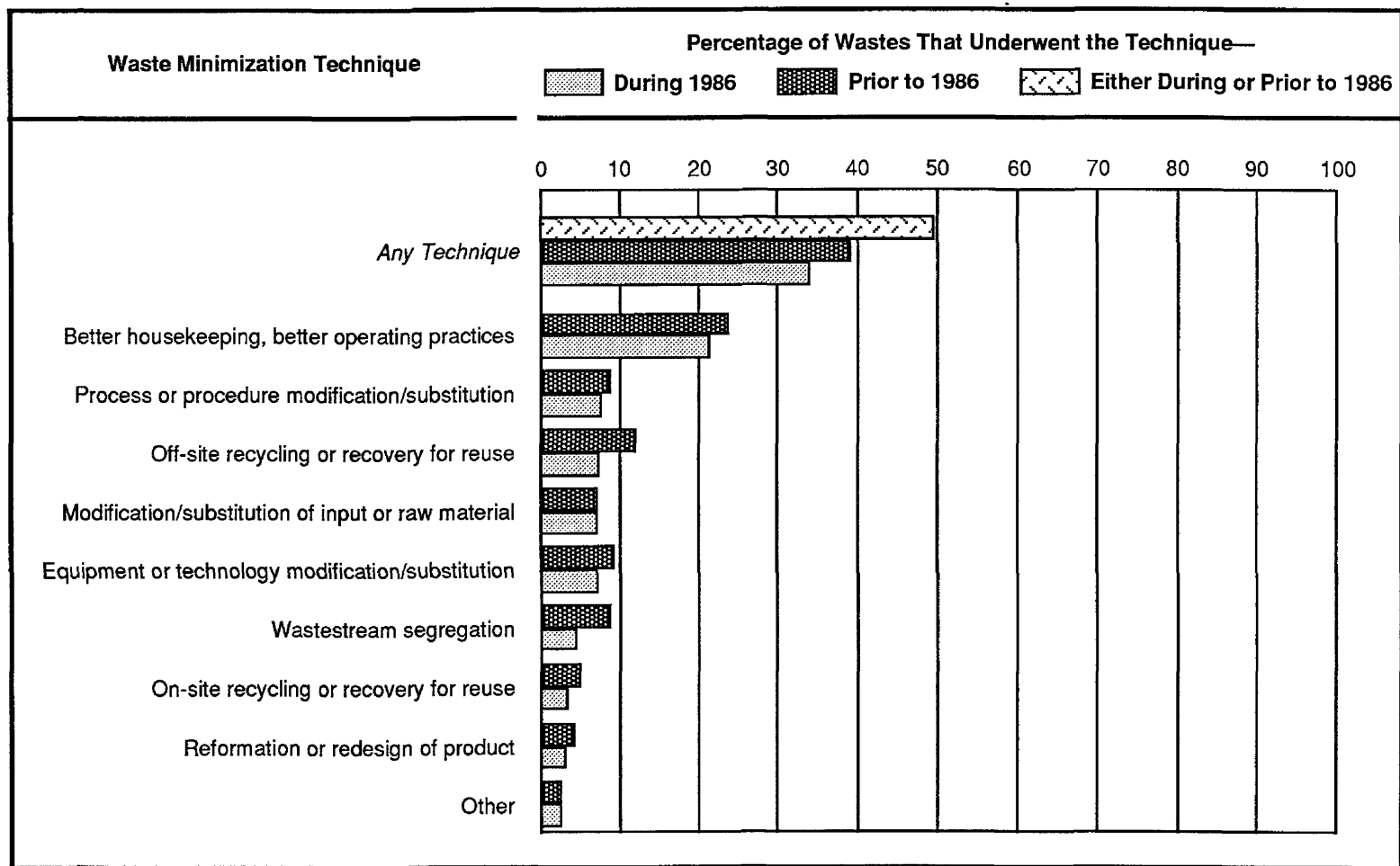


Figure 3-8. Waste minimization techniques implemented for individual hazardous wastes. Percentages indicate the number of wastes that underwent the technique indicated out of all hazardous wastes reported in the Generator Survey. A total of 2,862 hazardous wastes were reported in the Generator Survey. Source: National Survey of Hazardous Waste Generators.

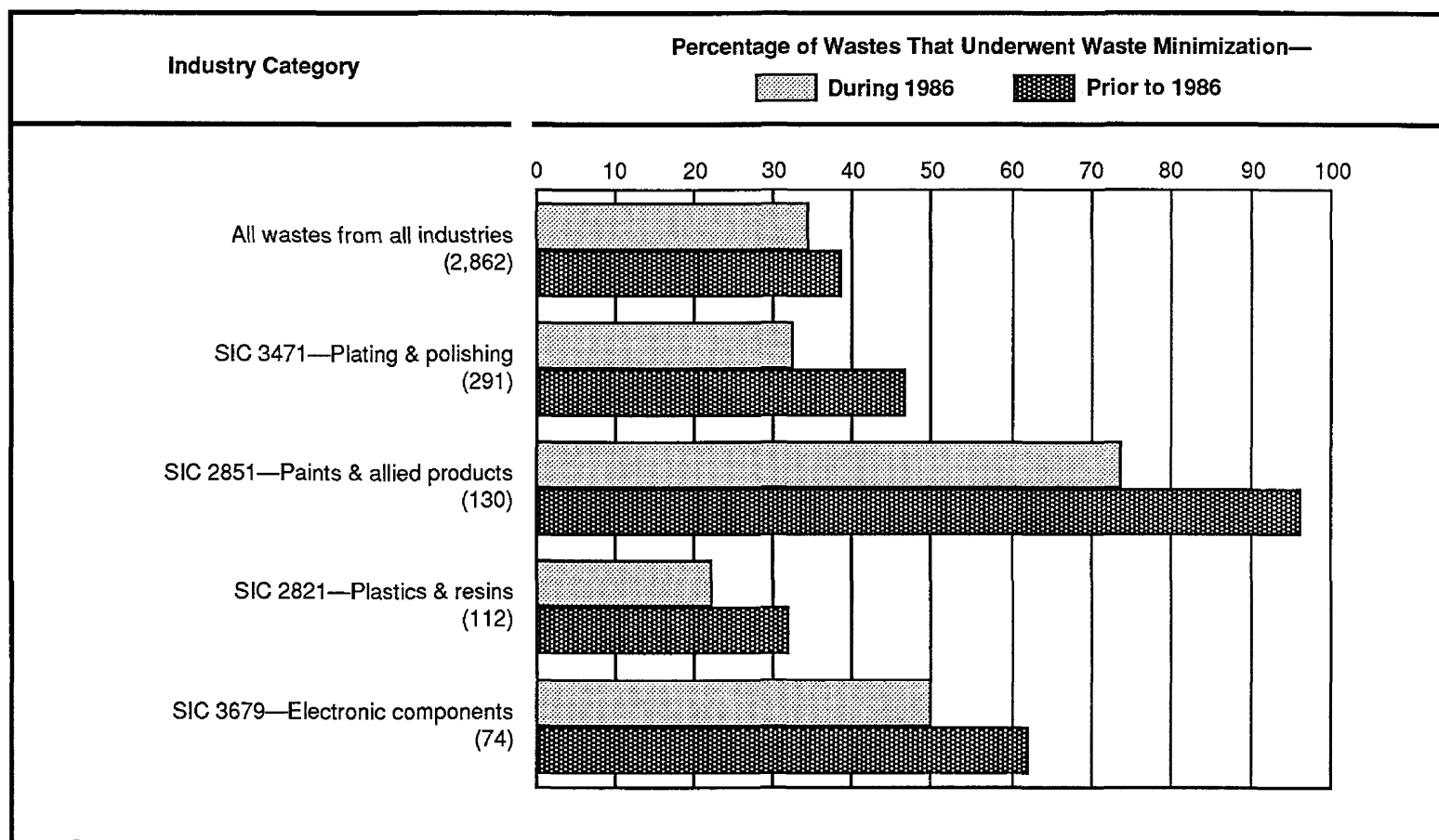


Figure 3-9. Wastes that underwent waste minimization activities by industry (SIC code). Numbers in parentheses under each category indicate the number of individual wastes generated in that category. Includes only wastes for which data on waste minimization are available. Industrial categories are not exhaustive. Only the top industries by the number of wastes they generated are shown. Source: National Survey of Hazardous Waste Generators.

Figure 3-10 categorizes waste minimization by waste-generating process. The waste-generating process is the activity that generated the hazardous waste. Wastes generated from one-time activities (e.g., spills, closure) are not included in the figure. These wastes may be difficult to minimize because they are not recurring; however, a facility may take precautions to decrease the likelihood of a spill. Laboratory wastes, which show the smallest percent of waste minimization in Figure 3-10, may also be generated through one-time activities and thus be difficult to minimize. Wastes from pollution control processes show the greatest percentage of waste minimization in Figure 3-10.

Wastes are categorized by RCRA waste code in Figure 3-11. Only the largest categories by the number of wastes in that category are shown. Of the waste codes shown, Spent Nonhalogenated Solvents shows the greatest percentage of waste minimization.

Finally, Figure 3-12 categorizes wastes by the quantity of the waste generated in 1986. In general, the figure shows that as the quantity of waste generated increases, the incidence of waste minimization activity also increases. This may indicate that

- facilities are prioritizing their waste and addressing their waste minimization efforts at the largest wastes,
- large wastes offer the greatest opportunity for recouping the costs of implementing a waste reduction activity, or
- larger facilities (which may generate individual wastes in greater quantities) may be pursuing waste minimization more than smaller facilities.

The one exception to this trend is wastes for which the quantity generated is greater than 10,000 tons. The wastes in this category underwent relatively little waste minimization. Further study is needed to draw any conclusions based on the data presented in these figures.

3.6 CONCLUSIONS

Data on waste reduction can be a valuable tool for policy analysis. Data can be used to evaluate the effectiveness of waste reduction programs and to indicate areas needing further government assistance. Unfortunately, no single indicator of waste reduction progress is currently available. A variety of indicators must be evaluated to

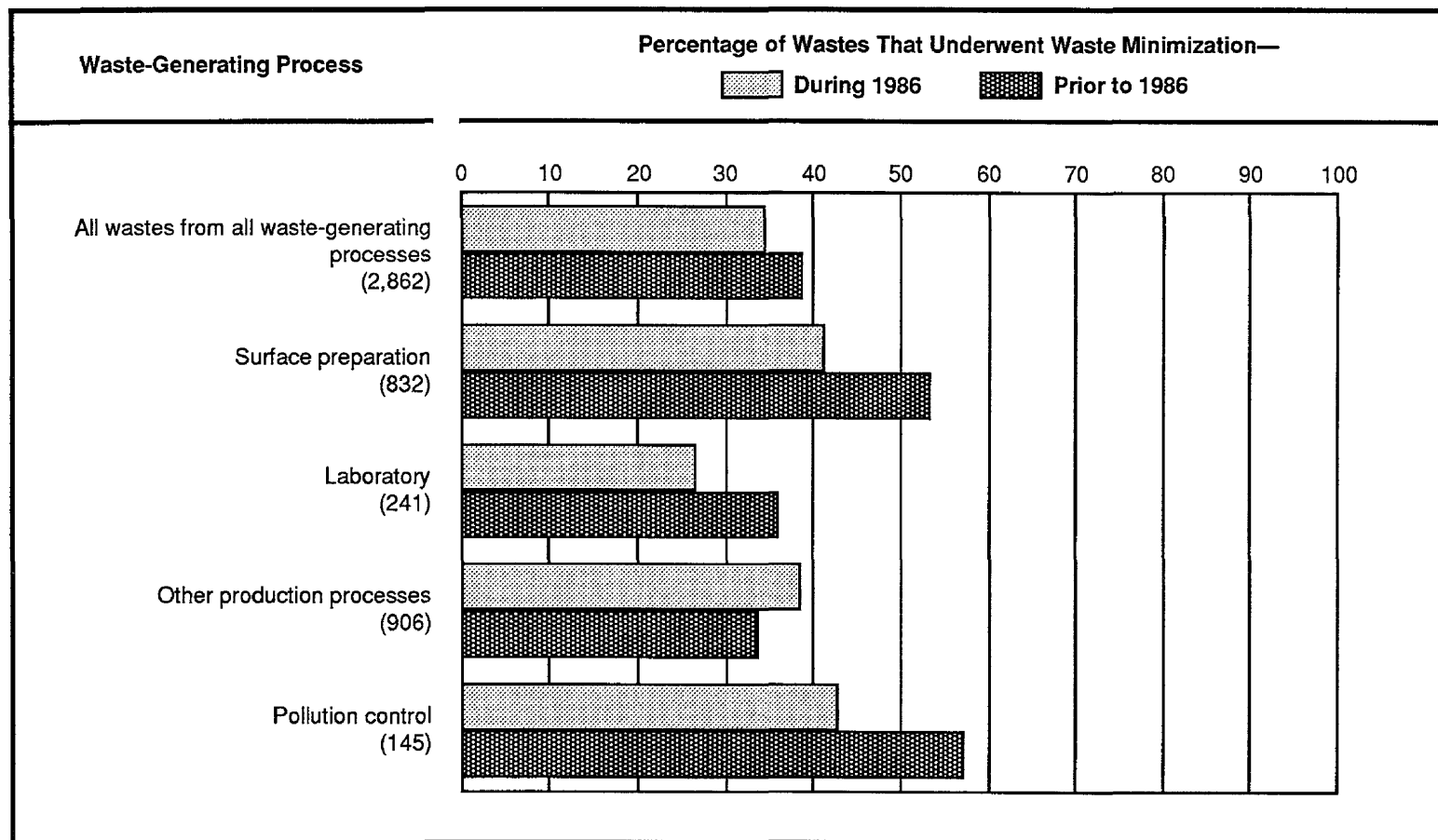


Figure 3-10. Wastes that underwent waste minimization activities by waste-generating process. Numbers in parentheses under each category indicate the number of individual wastes generated in that category. Includes only wastes for which data on waste minimization are available. All waste-generating processes are not shown. Source: National Survey of Hazardous Waste Generators.

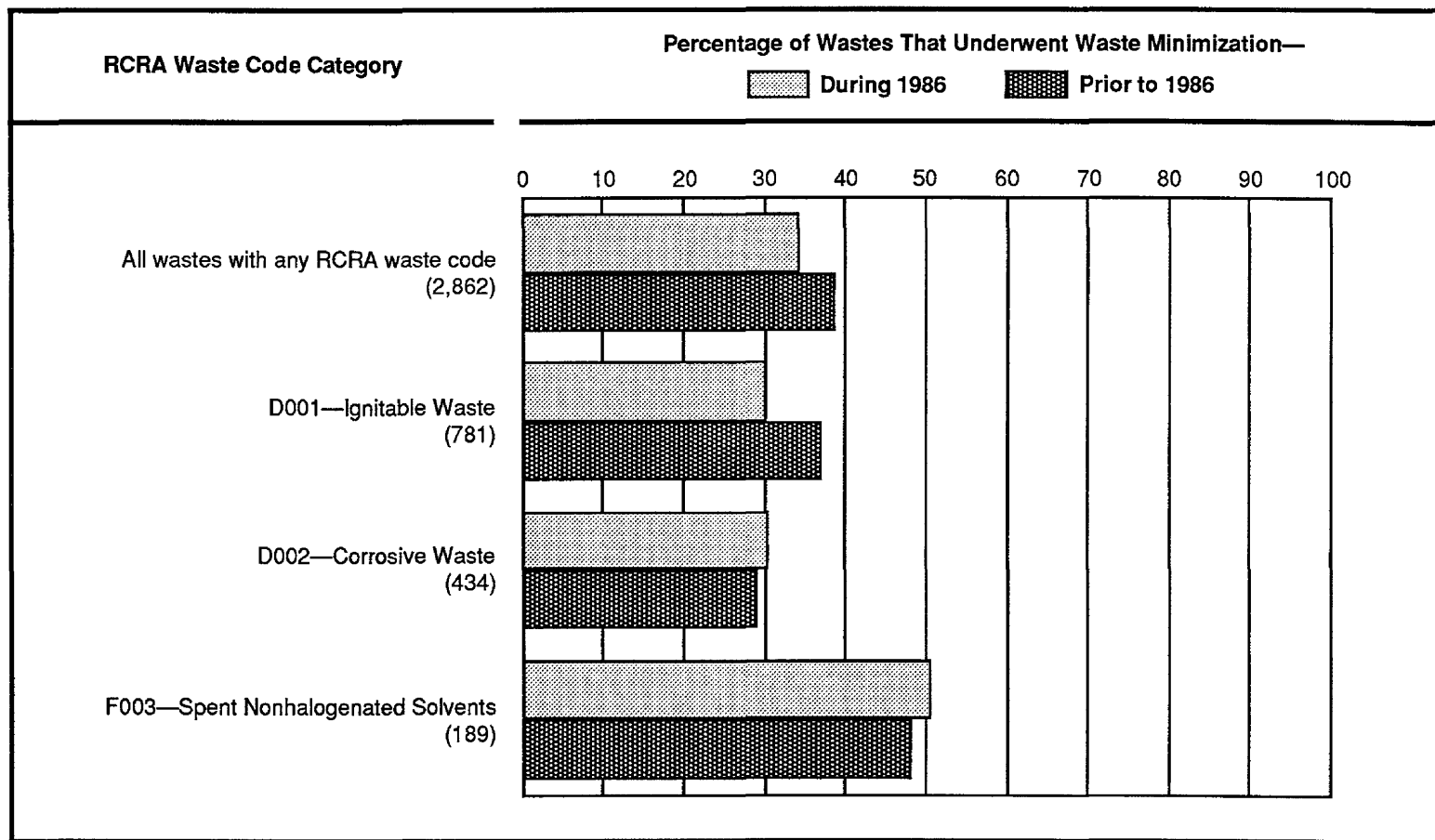


Figure 3-11. Wastes that underwent waste minimization activities by RCRA waste code. Numbers in parentheses under each category indicate the number of individual wastes generated in that category. Includes only wastes for which data on waste minimization are available. RCRA waste code categories are not exhaustive. Only the top waste codes by the number of wastes are shown. Source: National Survey of Hazardous Waste Generators.

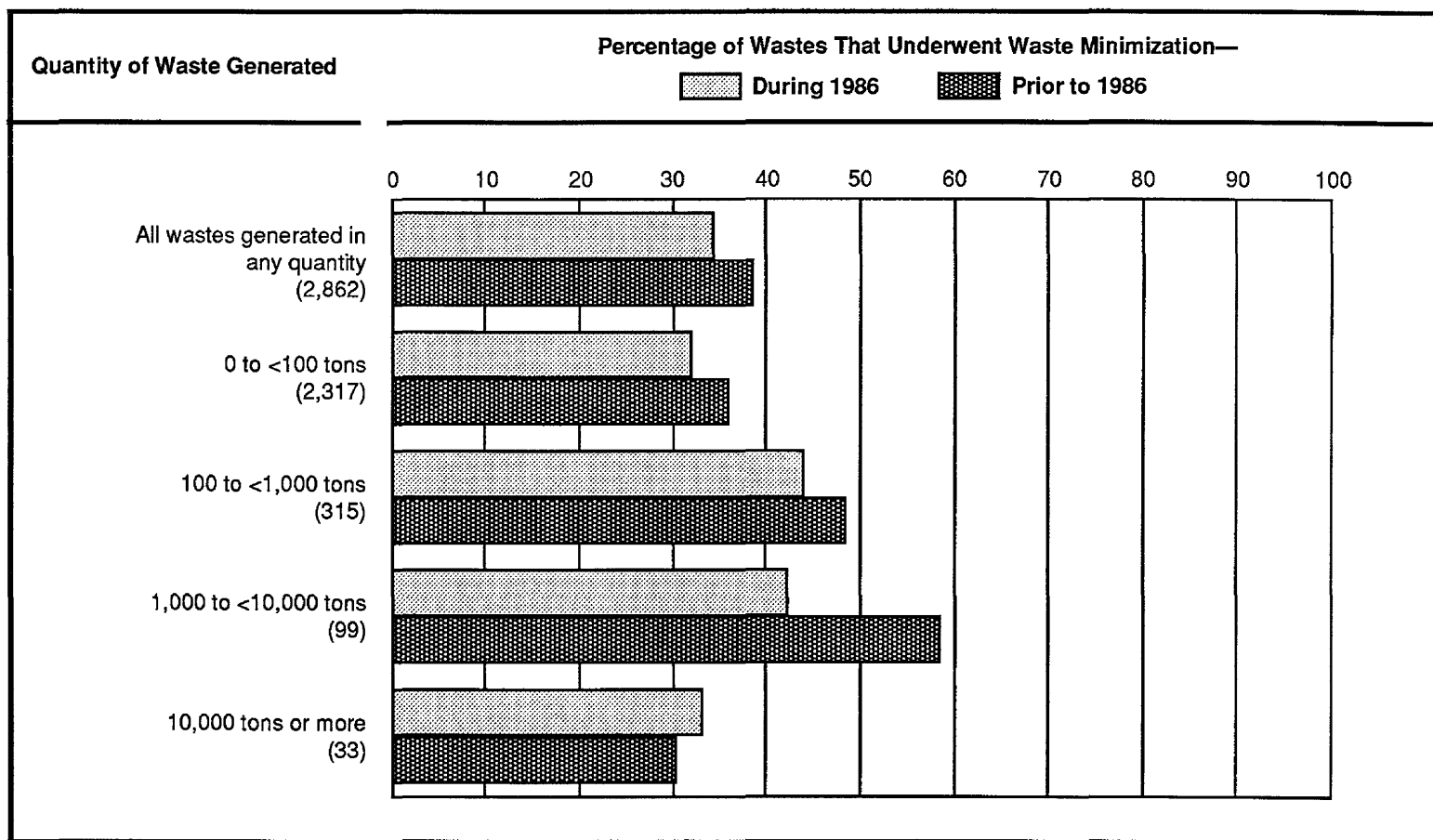


Figure 3-12. Wastes that underwent waste minimization activities by quantity of waste generated in 1986. Numbers in parentheses under each category indicate the number of individual wastes generated in that category. Includes only wastes for which data on waste minimization are available. Wastes for which the quantity generated in 1986 was not reported are not included in this figure. Source: National Survey of Hazardous Waste Generators.

make a complete and accurate assessment of waste reduction progress. Possible indicators of waste reduction progress include

- number of facilities implementing waste reduction during the reporting year,
- actual change in the quantity of waste generated from the previous to the reporting year (ACT),
- adjusted change in the quantity of waste generated from the previous to the reporting year (ADJ), and
- change in toxicity, ignitability, corrosivity, and reactivity of waste generated from the previous to the reporting year.

For further discussion of these and other indicators of waste reduction progress, see Section 3.2.

Data currently available on waste reduction in Illinois are not sufficient for evaluating waste reduction progress. Evaluating waste reduction requires a fundamentally different focus from current data collection efforts. Current data sources reflect the command-and-control regulatory environment, with its focus on regulating the quantity of waste released or the treatment methods used for a single environmental medium. Thus, in general, data currently available focus on wastes at the point of transfer off site or release to the environment for a single environmental medium. In contrast, waste reduction focuses on reductions in the generation of all industrial wastes prior to treatment or transfer. To evaluate waste reduction progress, the state and federal governments must move in the direction of focusing on all wastes at the point of generation. Such changes are being considered at the federal level.

Although the available data on waste reduction in Illinois do indicate some waste reduction progress at individual facilities in Illinois, data are not sufficient to determine whether state-wide progress has been achieved in waste reduction. Further study is needed to determine the extent of waste reduction progress achieved in Illinois and to indicate areas where further progress is needed.

REFERENCES

- Baker, Rachel D., and John L. Warren. 1989. "Evaluation of Measures Used to Assess Progress in Pollution Prevention." Draft report prepared for the U.S. Environmental Protection Agency, Pollution Prevention Office, Washington, DC.
- Hazardous Waste Research and Information Center. 1989. *Alternatives for Measuring Hazardous Waste Reduction*. Savoy, Illinois.
- Illinois Environmental Protection Agency. 1988. *Summary of Annual Reports on Hazardous Waste for 1984 through 1987: Generation Treatment, Storage and Disposal*. Springfield, Illinois, IEPA/LPC/89-011.
- Illinois Environmental Protection Agency. 1989a. *First Annual Toxic Chemical Report*. Springfield, Illinois, IEPA/ENV/89-012.
- Illinois Environmental Protection Agency. 1989b. *Illinois 1988 Annual Air Quality Report*. Springfield, Illinois.
- Perry, Lance G. 1989. *Composition of Nonhazardous Special Waste Streams Generated by Illinois Manufacturers*. Savoy, Illinois: Illinois Department of Energy and Natural Resources, Hazardous Waste Research and Information Center.

CHAPTER 4

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CHAPTER 4

TECHNOLOGICAL AND ECONOMIC CONSIDERATIONS

4.1 OVERVIEW

The purpose of Chapters 4, 5 and 6 is to assess the relative effectiveness of alternative policy options designed to increase waste reduction efforts in the industrial sector. This chapter examines the technical and economic aspects of waste reduction. Section 4.2 identifies the basic waste reduction techniques and uses examples to illustrate how industry can use these techniques to reduce waste generation. Many of these techniques have been successfully implemented by Illinois firms, as illustrated in Chapter 3. Section 4.3 presents our analysis of the economic aspects of waste reduction, which includes (1) the economic rationale for concern about waste management; (2) the concept of waste management as a production process and the incentives that producers respond to in selecting a particular mix of waste management inputs; and (3) the internal and external barriers to waste reduction, the significance of each barrier, and possible approaches to reducing or eliminating those barriers.

Our evaluation of waste reduction policy options in Chapter 5 considers the economic and technical aspects of waste reduction discussed in this chapter. Chapter 6 further builds on the analysis presented in this chapter and in Chapters 3 and 5 to develop a comprehensive waste reduction policy framework.

4.2 WASTE REDUCTION TECHNIQUES

Waste reduction in the industrial sector is a multifaceted process. The following sections describe a number of waste reduction techniques, ranging from simple acts to major process modifications. Responsibilities extend from the highest levels of management to the individual worker. Often, properly informed and encouraged employees give the best suggestions for waste reduction techniques.

This section describes specific techniques available to firms to reduce the quantity or toxicity of wastes generated or subsequently treated or disposed of. These techniques,

which can be grouped into three categories based on whether they constitute waste reduction, are as follows:

Category 1

- Waste reduction audits
- Waste reduction plan
- Management strategies

Category 2

- Better housekeeping/management
- Waste stream segregation
- Modification/substitution of input or raw material
- Reformulation/redesign of product
- Equipment/technology modification
- Process/procedure modification or substitution

Category 3

- Wastewater reduction
- On-site recycling or recovery for reuse
- Off-site recycling

Category 1 techniques do not actually reduce waste generation. Instead, they set up a framework that enables and encourages waste reduction. Thus Category 1 techniques are an important first step in any facility waste reduction program.

Category 2 consists of techniques traditionally viewed as waste reduction. Because they reduce the generation of waste at the source, these techniques fall under the very narrow definition of waste reduction used by the Office of Technology Assessment (OTA, 1986). This definition is discussed in Chapter 1.

Whether techniques in Category 3 are considered waste reduction depends on the definition of waste reduction used. Under the definition of waste reduction used throughout this report (see Chapter 1, Table 1-1) on-site recycling is considered waste reduction. Wastewater reduction may constitute waste reduction under our definition if it reduces the generation of wastewater at its source. Off-site recycling is not considered waste reduction under our definition. If waste reduction is not feasible, however, off-site recycling is usually the preferred waste management method.

4.2.1 Waste Reduction Audits

Although a waste reduction audit does not actually reduce waste generation, conducting a waste reduction audit should be a company's first step in any attempt at waste reduction. The concept of a waste reduction audit is similar to a financial audit performed by an accountant. An accounting audit tracks the flow of receipts and expenditures; a waste audit tracks the physical flow of raw materials through the production process. A sample waste audit checklist is provided in Appendix B.

Audits provide the information necessary for identifying potential waste reduction strategies and prioritizing waste reduction efforts. Audits also form the basis of a waste reduction plan, spelling out which waste streams will be reduced and how. Finally, waste reduction audits provide a basis for measuring the effectiveness of waste reduction efforts already in practice.

A waste reduction audit begins with an examination of the wastes currently being manifested for off-site treatment, storage, recycling, or disposal. This starting point is logical because federal and state regulatory requirements encourage detailed record keeping for these types of wastes and thus provide a reasonable database for estimating not only the types and quantities of wastes but also the raw material process inputs that led to waste generation. In Illinois, manifested wastes include both hazardous and nonhazardous special wastes. The record keeping must account for wastes that are sent to municipal disposal facilities and all wastes treated or disposed of on site.

The next level of effort is devoted to identifying the processes generating the wastes. This step can be difficult when wastes are aggregated within a plant before being turned over for disposition. The plant must make every effort to track each waste-generating process. Relying on intuition alone is insufficient. For example, a military installation performed a preliminary self-audit and identified 100 separate waste streams. A more detailed audit conducted by an outside consultant showed the actual number of waste streams to be in excess of 250 (Scola, 1989).

The next step of the audit examines the relationship between the amount of raw materials procured for the identified processes and the annual consumption and consumption per unit of finished product. Automated requisitioning systems should, when possible, properly flag materials with hazardous characteristics to permit the responsible corporate environmental official to easily aggregate and analyze use patterns.

In conjunction with such an audit, establishing production-normalized waste emission factors (i.e., factors that adjust waste generation rates for changes in the level of production activity) can provide long-term dividends because these factors allow the extrapolation of waste generation over the spectrum of operating levels. Detailed guidance for conducting a waste reduction audit can be obtained from a variety of sources including the Hazardous Waste Research and Information Center (HWRIC, 1989) and the U.S. Environmental Protection Agency (USEPA, 1988).

A detailed process analysis can help target specific areas where waste reduction could be implemented. It provides detailed information on both the process and the performance practices of the unit operations that make up the process. A detailed process analysis can suggest a spectrum of waste reduction strategies that might be applied to those processes. It also can provide a yardstick to measure the effectiveness of waste reduction actions initiated by the company.

For example, a process such as metal finishing may consist of a number of unit operations such as cleaning, degreasing, or filtration that prepare the items to be finished and prepare the finishing solutions. The performance of each of these operations may be codified in a Standard Operating Procedure (SOP) aimed at ensuring that all employees perform the operation in the same manner, thus ensuring the quality of the process output. Observing the process may identify waste-producing activities codified and perpetuated by the SOP and may reveal employee variants to the established procedure that either reduce or increase the amount of waste generated by the process.

4.2.2 Waste Reduction Plan

After completing a waste reduction audit, companies should formulate a waste reduction plan to formalize the waste reduction strategies to be implemented. At a minimum, the waste reduction plan should

- clearly state management's commitment to the principles of waste reduction,
- articulate the goals to be achieved, and
- present an analytical structure for determining the potential areas of waste reduction in the facility.

With respect to administration of the waste reduction program, the plan should provide for establishing a reduction opportunity evaluation committee. According to case studies, successful committees include at least one member from management and an

experienced line representative from each operating area of the facility (Kraybill et al., 1989). As was pointed out in Brown (1987), forming a linkage between the committee and the production managers is vital to implementing recommended changes. The committee should collectively receive training in the principles of waste reduction and thoroughly understand management's commitment to the waste reduction plan. Other important items to be included in the plan are

- general guidance on prioritizing streams to be examined for waste reduction opportunities,
- criteria for evaluating potential changes,
- mechanisms for gaining access to necessary company data and for requesting assistance from other plant personnel with specialized skills (i.e., cost estimation of process changes), and
- a reporting mechanism to upper management.

4.2.3 Management Strategies

To formulate and apply management strategies related to waste reduction, corporate management must undertake two actions. First, the highest level of corporate management must explicitly state the company's commitment to waste reduction and establish a corporate policy that holds each employee and supervisor accountable for the proper use and handling of all process inputs and the attendant waste, both hazardous and nonhazardous, generated from such materials. Second, management needs to thoroughly educate employees as to the importance of minimizing waste generation while performing their assigned work. Informed employees are an important source of information on waste reduction opportunities. This education must be continually reinforced through training and discussion in the same manner that safety programs are implemented.

From management's standpoint, all waste is undesirable because it represents an inefficient use of process inputs and thus a loss of potential revenue and a source of expense for the company. A recent study of the true cost of generating waste at an Illinois plastics plant (Kraybill et al., 1989) showed that nearly 90 percent of the cost was due to lost raw material. The problem of waste reduction takes on added importance for RCRA hazardous wastes. Employees who work with hazardous materials must understand that mishandling these materials may affect their health, damage the environment, and inflict costs on the employer in the form of bad publicity and major cleanup expense.

It may be especially difficult to educate those employees who have been using the same materials for a period of many years prior to the Employee Right-To-Know and Community Right-To-Know regulations. These employees may have difficulty understanding that these “old and familiar” materials are actually hazardous materials and consequently lead to hazardous waste. Employers must be committed to ensuring that all employees are thoroughly trained and have the proper equipment to safeguard their own well-being as well as to prevent unnecessary releases of materials with hazardous characteristics. Furthermore, employers must be committed to the policy that failure to properly handle such materials will be grounds for disciplinary action.

4.2.4 Better Housekeeping/Management

One of the least expensive actions a company can take to reduce the amount of waste generated is to improve housekeeping. Simple practices such as placing the end of a product transfer hose into a bucket rather than dropping it on the floor and allowing the contained product to spill on the floor can reduce loss of product and eliminate extensive washing of contaminated floors. Such a simple step can pay extensive dividends as was documented by Dow Chemical Company (Mitre, 1989). Other related improvements that require little investment but can reduce waste include container drainboards, which permit containers of materials to thoroughly drain their contents into the process tank; drip pans or drainboards, which capture drag-out (i.e., liquid residue that remains on a part after treatment) from immersion-type processes; and nozzle or zero head space valves on transfer lines, which prevent loss of material from the lines when transfer is complete.

Often, providing a proper receptacle at the point of generation of the waste can result in major savings. For example, simply installing automatic closure mechanisms on containers of volatile material and maintaining condensation coils on vapor degreasers can substantially reduce the volume of wasted material and consequent air pollution. Converting from water washdown of floors and equipment to dry vacuum cleaning can also substantially reduce the amount of waste produced.

4.2.5 Waste Stream Segregation

Mixing wastes in common receptacles or piping systems can be a dangerous practice in certain circumstances, especially when successive additions of waste material could lead to reaction and evolution of toxic gas or to an explosion. Even when such

catastrophic events do not occur, maintaining the integrity of individual wastes is an important step toward waste reduction.

Maintaining the integrity of a waste offers the potential for the reuse of certain inputs in successive, degradative applications. For example, virgin solvent may be required for cleaning precision parts such as bearings. The “dirty” solvent from this process, however, still has considerable cleaning capacity. It has the potential to be used, without treatment, for cleaning other parts that are to be repaired or rebuilt, and could successively be used for cleaning tools before being turned in as a waste for recycling or disposal. Some segregated wastes can be used in a manner different from their original intended use, such as the use of acidic waste to neutralize alkaline waste generated elsewhere in the plant.

Often, a large volume of waste may be classified as RCRA hazardous when only one, easily isolated, component is hazardous. Although it may not constitute waste reduction, segregating that one component can drastically reduce the volume of waste requiring treatment or disposal as RCRA hazardous waste.

4.2.6 Input/Raw Material Modification or Substitution

In many situations, modifying or substituting inputs can significantly reduce wastes. Important factors influencing the choice of inputs are the raw material purity, the linkage between the raw material and the cost of disposing of the hazardous waste, and the equivalence of performance of the substitute input versus the raw material.

4.2.6.1 *Raw Material Purity*

The detailed process analysis conducted as part of a waste reduction audit may target specific processes for reduction. One consideration when making process changes is the purity of the raw material. Some constituent or by-product of the production of the raw material itself might lead to the formation of hazardous by-products or the premature need to change a process bath. An example might be the grade of acid used to formulate a plating bath. Impurities in a less expensive grade of acid may result in undesirable side reactions, leading to shorter plating bath life than would be true if a higher purity acid had been purchased.

4.2.6.2 *Cost Linkage*

For chemical processes in which several alternative feedstocks may be used, the feedstock with the lowest unit cost may not be the best value if the transforming reaction

forms undesirable by-products and generates wastes during the product isolation and purification steps. Substituting a different raw material may minimize the formation of undesirable by-products or may improve reaction yield efficiency.

It is important to provide some linkage between the purchase cost of raw materials involved in processes producing hazardous waste and the cost of hazardous waste disposal. If such a linkage is not established, the procurement process will be governed simply by the lowest possible unit cost of raw material. As such, a material that seems like a good value at 20 cents per pound might be chosen over another at 30 cents per pound whereas the difference in disposal cost between the two materials might be on the order of tens of dollars per pound of spent material.

4.2.6.3 *Establishing Equivalence*

Securing labor and management acceptance of a substitution of raw material in the waste reduction effort requires substantiating equivalent or superior performance of the substitute material when compared to the current material. This equivalence must be shown from several aspects as described below.

Functional Equivalence. One aspect of substituting one raw material for another is the establishment of measurable functional equivalence—the ability of the substitute material to accomplish the same task to the same degree as the original material. When examining the issue of raw material, a “value engineering” approach has been shown to be beneficial. Such an approach addresses three questions:

1. What does the material do?
2. How does it do it?
3. How else might it be done?

To illustrate, in the case of a chlorinated solvent used for cleaning metal parts, the answer to the first question, obviously, is that it cleans the part. The answer to the second question is that it dissolves the grease and oil that binds the dirt to the part. The answer to the third question is considerably more complicated; it is related to the answer to the second question. One could remove the grease and dirt by soap and water, or one could heat the part to lower the viscosity of the grease and cause it to run off, or one could look for a nonhazardous solvent that could be used or for a solvent whose ease of recycling eliminates disposal as a hazardous waste.

The decisions related to the answers to the third question can only be made by someone with intimate knowledge of the delicacy, form, and function of the part to be cleaned. Three other questions must be addressed:

1. Will the part be damaged by heat?
2. Is the part made of a material that will be attacked by certain types of solvents?
3. Is the industrial wastewater treatment plant capable of handling the increased load of emulsified oils and greases if a water wash is used?

The analysis of functional equivalency is in essence a waste trade-off analysis. In the example above, the analyst determines the relative efficacy of a solvent that creates air pollution and requires recycling, treatment, or disposal; a water wash that trades solvent waste for water pollution and the attendant treatment sludge; and a heat process that may contribute to air pollution. USEPA's Pollution Prevention Office addresses releases to all media. Determining the most environmentally satisfactory release will require establishing a system of equivalency (i.e., X pounds of chemical oxygen demand in wastewater is equal to Y pounds of volatile organic carbon emitted to the air and to Z pounds of sludge requiring burial). No such valid system of equivalency exists to date.

Performance Equivalence. When candidate alternatives have been identified, the issue of performance equivalence must be addressed. In the case of the solvent example above, the issue of the degree of cleanliness achieved by each alternative must be addressed. Performance equivalence is often dependent on the tolerance of the next downstream process to which the part is to be subjected. The availability of objective measures of the parameter—in our example, degree of cleanliness—makes the job of establishing equivalence much easier. Often in established industries, national standards groups such as the American Society for Testing and Materials or the American National Standards Institute are good sources of such tests. Trade organizations such as the American Electroplating and Surface Finishing Society are another good source of test procedures.

Productivity Equivalence. The final evaluation of equivalence addresses the question of productivity equivalence. Adopting a substitute material or method ideally should not incur a productivity penalty. The economic impact on the overall process of substituting a five-minute cleaning process with one that takes additional manpower and time must be carefully evaluated—including the change in cost of total waste disposal. In some instances, e.g., batch cleaning, the delay is insignificant if the parts can be set to

soak overnight and be available for use in the morning. In automated processes in which large production runs are usual, a soak loop can be installed to provide the required cleaning time, leaving downstream processes unaffected.

4.2.7 Product Reformulation/Redesign

A more extreme and often expensive approach to waste reduction entails the reformulation or redesign of the product. This assumes that such a product exists that performs a useful function and has a market. Reformulation to reduce waste may result in customer confusion unless the reason for the change is carefully explained and the customer is assured that the reformulated product will equal or surpass the former product in performance. In most instances, careful technical evaluation is required to make an informed decision.

4.2.7.1 Reformulation

If suitable substitutes exist, reformulation of a product to reduce or eliminate a hazardous component or otherwise reduce the amount of waste (hazardous or nonhazardous) that is generated can often be accomplished with a minimal capital investment. When no suitable substitutes exist, more significant investment may be required. For example, reformulating a paint from an oil base to a water base may require re-piping the process, processing additional raw materials, and using different containers.

4.2.7.2 Product Redesign

Major expenditures of engineering effort and capital investment are often required to redesign a product. For parts whose processing involves electroplating, the producer should determine the reason behind the particular plating operation. For example, in the case of a chrome-plated object, the producer needs to determine the purpose of the chrome plating and possible redesigns, as shown below.

Purpose of Chrome Plating	Redesign Considerations
Hardness or wear resistance	<ul style="list-style-type: none"> • Use ceramic inserts or special heat treating of a metal part.
Corrosion resistance	<ul style="list-style-type: none"> • Develop new metallurgical techniques such as ion-vapor deposition aluminum. • Abandon metal part and substitute a machineable plastic.
Decorative	<ul style="list-style-type: none"> • Substitute another coating that does not change.

4.2.8 Equipment/Technology Modification

One of the more expensive waste reduction options is to modify equipment or change the process technology. Certain simple modifications such as designing plating fixture racks or baskets to minimize drag-out of immersed parts may be within the capability of the plant maintenance department. More significant modifications such as replacing standard immersion cleaning with ultrasonic cleaning and replacing conventional machining with laser or electrostatic discharge metal removal techniques require considerable engineering investigation and a rigorous economic analysis. The avoided cost of not having to manage and dispose of certain wastes as a result of the change must be factored into the economic analysis to present an accurate picture for decisionmakers.

4.2.9 Process/Procedure Modification or Substitution

Process or procedure modification can be effective in reducing, and in some cases eliminating, the amount of waste generated by a process. This type of waste reduction ranges from simple, low-cost changes to complete technology replacements.

4.2.9.1 *Simple Steps*

Relatively low-cost, simple steps include increasing the drain-time between hoisting a fixture or part from an immersion process and moving the fixture from over the immersion tank. Other simple process modifications include using air-agitated immersion cleaning, installing air curtains to strip excess free liquids from a part, and filtering solids from cleaning solutions to extend bath life.

4.2.9.2 *Complex Technology Replacements*

More complex process changes usually involve considerable engineering investigation before implementation. Such changes can result in wholesale replacement of a process with a more effective or more efficient technology. Two examples of such changes are presented in the literature (California Department of Health Services, 1988) and summarized below.

Example 1:

A crankshaft repair facility replaced a caustic jet spray degreaser with a "burnout oven," which raised the temperature of large metal parts above the combustion point of the grease and oil coating. The oven was

equipped with an afterburner and met all environmental requirements—the residue ash on the parts was subsequently removed by glass bead or steel shot blasting. The ash and beads proved to be nonhazardous and suitable for conventional landfill disposal. Savings resulting from avoiding disposal of 110 gallons per month of caustic solution paid for the new oven in 5 months (the blasting system was already in place).

Example 2:

A major automobile assembly plant replaced a conventional air-atomized spray paint operation for applying a base coat with an electrostatic paint system. The electrostatic system gives the paint particles a positive charge as they leave the spray nozzle while holding the item to be painted at a strong negative potential. The difference in charge causes the paint particles to be strongly attracted to the target item. Using the electrostatic system the plant dramatically reduced overspray and improved transfer efficiency from 30 percent to 90 percent. Painting a vehicle required as little as one-third of the paint formerly used. The waste stream dropped dramatically, raw material (paint) was saved, and the process change was estimated to pay for its multimillion dollar investment in two years.

4.2.9.3 *In-Process or Closed-Loop Recycling*

Closed-loop recycling takes place completely within the original waste-generating process. With closed-loop recycling, wastes reenter the production process as raw materials with little or no treatment. Because implementing closed-loop recycling involves changing the production process, it is commonly characterized as a process change rather than as a recycling technique.

4.2.10 Wastewater Reduction

A wide variety of steps can be used to reduce wastewater generation in an industrial plant. While not all reductions in wastewater constitute waste reduction, such efforts as water conservation can generate significant cost savings including

- the obvious savings in the cost of treated water,
- the cost avoidance of providing treatment plant capacity or paying surcharges for uncontrolled water use, and
- the potential for more efficient wastewater treatment when the constituent to be removed is present in more than trace concentrations.

Many water conservation steps can be achieved with a small capital investment. Equipping hoses with nozzles with “dead man” controls stops the flow when the user no longer is holding the hose and prevents the common practice of an intermittently used

hose being left running for an entire shift. Multiple tank immersion rinsing operations have the potential for conversion to countercurrent rinsing and for using an easily monitored parameter (e.g., electrical conductivity) to control makeup rinsewater. Some regular hose and detergent washing operations may be replaced with fluidic nozzles, high pressure, hot water, or combinations of these techniques. Using water-conservation devices along with avoiding emulsification of greases and oils by surfactants not only reduces the volume of wastewater to be treated (and the attendant sludge) but also improves the treatability of the wastewater.

4.2.11 On-site Recycling or Recovery for Reuse

On-site recycling and recovery for reuse can prove economical from many aspects. First, the volume of waste for disposal is substantially reduced. Second, a useful product is recovered for use in the plant; and third, the cost of managing the waste can be substantially reduced because the waste does not leave the premises for treatment or disposal. Several opportunities for recycling are discussed below. Each represents a different approach that ultimately reduces the volume of waste requiring disposal.

4.2.11.1 *Cascade Reuse*

Cascade reuse is the consecutive use of a material with little or no treatment between uses. Each successive use must be tolerant of the degraded state of the material. An example of cascade reuse with solvents is described in Section 4.2.5. An equivalent system for water can easily be visualized.

4.2.11.2 *Transport Water Recycling*

When water is used for transport purposes, reuse potential is high and requires a small amount of processing. Often the water is used to carry away insoluble solid materials (e.g., dirt, metal shavings, paint particles) from a process. Because the water's role is merely transport, removing the solid material through settling hydrocyclone, filtration, or centrifugation permits repeated use of the water. In such a closed-loop system, water would be added only to make up for evaporation and the moisture lost with the solid residue.

4.2.11.3 *On-site Distillation*

Some solvents lend themselves to recycling on site. Distillation technology has progressed to a point that small, batch-operated, semi-automatic stills are available to

meet most needs. Experiments conducted by the U.S. Army (Donahue, 1986) have shown the ability of such stills to produce Stoddard solvent and 1,1,1-trichloroethane that meet military specifications for virgin material. Military specifications are often more restrictive than equivalent commercial standards for equivalent materials. In the case of the 1,1,1-trichloroethane, the level of corrosion inhibitor in the distillate was insufficient to meet military specification, but a 50/50 blend of recycled and virgin solvent met the specification because virgin (i.e., nonrecycled) solvent has an excess of the corrosion inhibitor present. Alternatively, inhibitor could be added to the recycled product to meet the requirement.

4.2.11.4 Custom Recycling

Custom recycling at the plant site is another option. At least one service company, based in Ohio, has received approval to provide this service in several states. The company arrives at the plant site with a highly sophisticated mobile recycling system. They arrive “clean”; process the accumulated solvents in their mobile system; clean the equipment, leaving the still bottoms (leftover solid residuals) and cleaning liquid at the plant for disposal by the generator; and leave the plant site in a “clean” condition.

4.2.11.5 Recycling as Fuel

One of the most controversial techniques for recycling permitted by regulators is the recycling of combustible materials as fuel. Experts disagree on whether this practice should be considered recycling. Some argue that recycling combustible materials as fuel represents destruction of the waste and is therefore a treatment process. Others argue that the process recovers one valuable component, the energy value of the waste. At any rate, this technique should be considered the last waste management option before disposal.

Recycling as a fuel component is feasible for wastes that are combustible, are compatible with industrial fuels, and produce no hazardous products upon combustion. Wastes such as used lubricating oils and nonchlorinated aliphatic and aromatic solvents often can be recycled in this manner. Blending hazardous waste with the fuel requires care to reduce the possibility of contaminating a large volume of nonhazardous fuel if the system malfunctions. Permits for such recycling may be required. Avoiding accumulation of large quantities of waste before blending is necessary to minimize the risk of spills.

4.2.12 Off-site Recycling or Recovery for Reuse (Waste Exchange)

Although it does not constitute waste reduction according to our definition, off-site recycling reduces the quantity of waste that must be disposed of. Off-site recycling has been practiced in some industries for many years. Usually the materials recovered had high value or were too expensive to recover in small batches. Examples include the petroleum refining and chemical process industries' efforts to rejuvenate or recover valuable components of catalysts. Off-site recycling opportunities have expanded with the passage of hazardous waste regulations. Several types are discussed below.

4.2.12.1 Custom Re-refining

Custom re-refining of solvents is a service available in many major metropolitan areas. The generator accumulates the solvent over a period of less than 90 days and ships it to a recycler who processes the waste without co-mingling it with the wastes of other generators and returns the recycled solvent to the point of origin. Depending on the terms of the service contract, the recycler may return still bottoms and equipment cleaning materials to the generator for disposal or may dispose of them as part of the recycling service. In the latter event, one concern is the potential for continuing liability by the originator of the waste in the event that the recycler improperly disposes of the residues.

4.2.12.2 Service Contract

An alternative solution to custom recycling of cleaning solvents is a service contract. Here a contractor provides users of the solvent with quantities of clean solvent and often the equipment necessary for efficient solvent cleaning. The contractor periodically removes containers of spent solvent for recycling, immediately replacing them with containers of new or recycled solvent. In Illinois, companies such as Safety Kleen and Solvent Systems provide such services for solvents. The spent solvent is returned to the contractor's site for mixing with similar solvent containers from other customers and is then distilled in bulk in commercial stills to replenish the contractor's inventory of solvent.

A service contract can provide several benefits to solvent users because they do not own the inventory of solvent. The service contractor takes care of any permits required by regulators for manifesting the spent solvent from the site for purpose of recycling. However, the question of individual customer liability for the distillation residue from processing batches where several customers' spent solvent have been blended is unclear.

4.2.12.3 Waste Exchange

Various processes require differing degrees of purity of input raw materials. As such, waste or spent material from a manufacturing process may have value as an input to another, different process. In essence, what is waste to one manufacturer may be suitable as raw material to another manufacturer.

To facilitate the linkage between sources and potential users, many states have established waste exchanges. In Illinois, the Industrial Material Exchange Service (IMES) is operated by the Illinois Environmental Protection Agency (IEPA) in cooperation with the Illinois State Chamber of Commerce. These clearinghouses receive information provided by generators on the quantity and chemical analysis of materials no longer suited for their original use. The waste exchange publishes the availability of the materials and may, through its own or allied resources, identify potential user industries. The waste exchange also can provide separate communication to these potential user industries on the availability of the commodities.

When a suitable match is made, arrangements are made between the source and receiver for transfer and possible payment for the material. (IMES does not participate in negotiations between potential exchange clients nor is IMES involved in the actual exchange of materials.) In some instances a brokerage fee is charged to the source and is used to support the activities of the clearinghouse. Even in those instances where the spent material is transferred without payment, the source industry realizes benefit in the form of cost avoidance for disposal of the material as hazardous waste with all the attendant management costs and potential liability.

4.3 ECONOMIC CONSIDERATIONS

Before proceeding to a discussion of the economic aspects of waste reduction it is important to clarify two points: 1) the role of economic analysis within the broader policymaking framework, and 2) the economic motivation for assessing waste management in general.

4.3.1 Economic Analysis and Public Policy

Economic analyses are regularly included as part of the assessment of the effects of a proposed public policy. Economic analysis is concerned with the costs and benefits associated with a specific policy option and, in particular, the magnitude of the costs and

benefits and who will bear them. The emphasis on economic analysis results from the desire to achieve results that are efficient (i.e., maximize the benefits or minimize the costs resulting from a particular decision).

Efficiency is only one of many criteria that are used in developing public policy, however. Other important criteria include equity, feasibility, and effectiveness as each relates to the ultimate goal of the policy in question. As such, the discussion that follows sheds light on only one part of the problem confronting policymakers. Nonetheless, we must fully understand the economic effects of waste reduction and how economic considerations affect decisions regarding waste reduction.

4.3.2 Economic Motivation for Assessing Waste Management

Viewed from the perspective of firms that generate waste, waste reduction constitutes an alternative to off-site recycling, treatment, or disposal as a way of managing the wastes generated by an existing production process. Assuming that most waste reduction takes place in the context of existing production processes, considering waste reduction to be a waste management option is useful for the purposes of this analysis. In particular, we will be able to more accurately describe the factors firms must consider when deciding on the type and extent of waste reduction strategies and techniques they should adopt.

All production and consumption activities ultimately lead to the creation of wastes. As noted in Kneese and Bower (1979),

When materials—minerals, fuels, gases, and organic materials—are extracted and harvested from nature and used by producers and so-called consumers, their mass is not altered in these processes, except in trivial amounts. Materials and energy residuals are generated in production and consumption activities, and the mass of the former must be about equal to that initially extracted from nature (pp. 5-6).

In an economy where all the costs associated with the generation and management of wastes were accounted for in production and consumption decisions, there would be no need for a governmental waste management policy. This is because all the costs would be internalized (i.e., accounted for) and hence resources would be allocated efficiently to the production of all products and services.¹ In our nation's economy, however, all the costs associated with waste management are not internalized.

¹This statement assumes that the economy is characterized by competitive markets and full information.

Past waste management practices have imposed considerable “external” costs on society. External costs are costs not considered by an individual or individuals when making a private decision. For example, the land disposal of hazardous wastes has reduced environmental quality and adversely affected human health, and it poses a continuing risk of additional negative effects. To the extent that these external costs are not considered by the firm in its production decisions, an inefficient level of output is produced. In addition, the firm’s waste management is inefficient.

From an economic perspective, then, the question is this: For the firm, what constitutes the economically efficient level of each waste management option—reduction, recycling, treatment, and disposal—considering both the private and external costs associated with these activities? The answer to this question requires knowledge of the social costs and benefits of each activity. The term “social cost,” as it is used here, refers to the sum of the private and external costs associated with a particular activity, where private costs refer to the out-of-pocket expenses incurred by the firm. In a similar fashion, “social benefits” are equal to the sum of the private and external benefits associated with the activity in question. According to economic theory, the net social benefits (i.e., the amount by which total social benefits exceed total social costs) of an activity are maximized when the activity is continued up to the point where the marginal (additional) social benefits of the activity are just equal to the marginal social costs incurred.²

For efficient waste management to occur, it is necessary to identify all the benefits and costs—both private and external—that are incurred. In the discussion that follows, we address this issue by focusing on the economic aspects of waste reduction and then expand the discussion to consider the economic aspects of waste management in general.

4.3.3 Economic Aspects of Waste Reduction

The economic aspects of waste reduction can be analyzed and assessed on different levels and from a variety of perspectives. Waste reduction has the potential to confer substantial benefits on the entire population. In addition to potential benefits, however, waste reduction may impose substantial costs on affected individuals. The benefits and costs resulting from waste reduction initiatives can be categorized according

²Marginal benefits” and “marginal costs” refer to the benefits and costs of each additional unit of the activity in question. The condition for maximizing net social benefits assumes that marginal social benefits (MSB) are initially greater than marginal social costs (MSC). Note that if $MSC > MSB$ for all levels of the activity, the socially efficient level of the activity is zero.

to the affected individuals. These individuals fall into four different groups—industry, consumers, society, and government.

A number of affected individuals are included under the heading of “industry.” These individuals include firms’ managers, employees, and stockholders. The term “consumers” is used to refer to individuals who purchase the goods and services and are affected, directly or indirectly, by waste reduction initiatives undertaken by firms. “Society” refers to consumers of environmental quality (i.e., those who benefit from improved environmental quality). “Government” refers to the agencies charged with the responsibility of improving social welfare in general and environmental quality in particular.

4.3.3.1 *The Benefits of Waste Reduction*

Industry. Industry has the potential to realize substantial benefits from waste reduction, primarily in the form of lower production costs per unit of output. Production costs can be reduced as a result of

- decreased recycling, treatment, and disposal costs (where recycling refers to activities outside the plant);
- the use of different and potentially less expensive raw material inputs;
- the installation of more productive capital that also results in reduced waste generation;
- increases in the productivity of capital, labor, and other raw material inputs as a result of process changes or input substitutions;
- reuse or recovery of inputs to the production process and the corresponding reduction in demand for raw materials (as a result of recycling or waste recovery within the production process);
- reductions in the cost of complying with other pollution-related regulations;
- reduced liability associated with waste treatment and disposal practices, such as the long-term liability associated with the land disposal of hazardous waste;
- avoided cost of potential new regulations governing wastes that are reduced or eliminated;
- less worker time lost to spill cleanup, equipment maintenance, and production downtime;
- improved purchasing patterns that result in fewer stocks becoming wastes as a result of expired shelf life;
- improved worker safety; and
- reduced insurance costs.

Waste reduction also reduces the need for limited waste disposal capacity, all else constant, and may consequently prevent the costs of increasingly scarce treatment and disposal options from rising at rates projected to prevail in the absence of waste reduction.

Waste reduction efforts may improve product quality as a result of modifying production processes or making input substitutions, developing better inputs, and introducing product modifications intended to reduce waste generation. Improving product quality may increase sales. All else constant, decreased costs and increased sales will increase the firm's profits.

Industry also has the potential to benefit by improving its public image as a result of efforts to reduce the amount of waste it generates and disposes of. To the extent that consumers base their purchasing decisions on the reputations of producers, environmentally conscious consumers may be attracted to the products of firms that are recognized for their efforts to use environmentally sound production techniques. Consequently, an improved image may also enhance a firm's sales and level of profits.

Consumers. Consumers derive several benefits from waste reduction efforts. A firm's reduced production costs may be reflected in reduced product prices. Product quality may improve as a result of waste reduction efforts. Changes in production processes may result in products that pose a lower degree of hazard or risk during their use. For example, a firm might alter a pesticide or herbicide by using less toxic or hazardous inputs to produce the product, thereby reducing the amount of hazardous waste generated. If the product poses less risk to the user, the user benefits as well.

Society. Waste reduction benefits society in several ways. Reducing the amount (and often toxicity) of waste that must undergo treatment or disposal improves environmental quality. Reducing the amount of hazardous waste reduces the risks of adverse health effects borne by society that are associated with hazardous waste recycling, treatment, and disposal as well as transportation of those wastes from the point of generation to the recycling, treatment, or disposal facility. From a long-run perspective, a reduction in waste disposal also implies a reduction in the amount of remedial efforts that society may have to pay for over time.

Referring to the pesticide example cited earlier, altering product formulation can also affect the long-term implications of a waste material. For example, altering a

pesticide or herbicide to reduce the amount of waste generated and the risk posed to the user simultaneously reduces the risk to society at large.

Reducing the amount of industrial waste for disposal in municipal landfills has the potential to benefit consumers of waste disposal services. To be specific, reducing the demand for waste disposal capacity at municipal waste landfills by the industrial sector reduces the burden on already scarce landfill capacity. As such, consumers may enjoy smaller price increases for waste disposal over time for two reasons. First, the capacity available for disposal of nonindustrial waste increases. Second, consumers may not be forced to use other, presumably more expensive, waste management alternatives as quickly as they would otherwise.

Efforts to reduce the amount of industrial waste that is generated may also create new employment opportunities. For example, at the firm level, efforts directed at waste reduction may require additional labor inputs and therefore increase the level of employment within the firm. Moreover, waste reduction efforts that result in lower production costs and increased sales may allow the firm to expand, thus creating new jobs. On a broader level, technological innovations may give rise to new industries that specialize in the production of capital that embodies specific waste reduction techniques.

In addition to the problem of negative external costs associated with waste management, the production of waste also means that a certain amount of productive resources are lost during the production process (i.e., the production process is not perfectly efficient).³ Waste reduction, by definition, implies a more efficient use of resources. From society's perspective this means that more goods and services can be produced with a given amount of resources. Consequently, successful waste reduction initiatives can help alleviate the problem of resource scarcity.

Finally, waste management activities including recycling, treatment, and disposal require the use of scarce productive resources including labor, raw materials, and land. As the amount of waste reduction increases, these resources can be reallocated to the production of other goods and services.

Government. Governmental units at the federal, state, and local levels expend a considerable amount of resources on developing, monitoring, and enforcing policies, e.g., regulations, designed to ensure the safe and effective management of industrial wastes.

³By "perfect efficiency" we mean that 100 percent of all resources (raw materials) are converted to valuable outputs in the production process.

These expenditures impose a cost on society in the form of foregone benefits of alternative government programs or private goods. Reducing the amount of wastes that are generated and subsequently managed could reduce these costs by reducing the amount of effort expended on administration of pollution control regulatory programs.

4.3.3.2 *The Costs of Waste Reduction*

Industry. As stated earlier in this report (Chapter 3, Section 3.5.2.2), the most common barrier to waste reduction is when the costs of instituting a waste reduction technology outweigh the potential savings. In many cases, to institute waste reduction, firms must undertake new and expensive capital investments or substitute more costly raw materials for less costly ones. To the extent that waste reduction requires the modification of existing production processes, changes in product design, input substitutions, or investment in research and development, costs will be incurred.

It is generally assumed that the objective of the firm is to maximize profits. It is reasonable to expect that the firm will attempt to minimize the costs of producing whatever level of output it chooses. As such, it is important to recognize that from the firm's perspective, improving existing capital equipment, purchasing new capital, using more expensive raw materials, and operating and maintaining modified production equipment all constitute additional costs. These costs must be factored into an analysis of the net benefits to the firm of waste reduction efforts.

In some cases, a firm's waste reduction strategy consists solely of purchasing new equipment. In this case, the firm may be interested in the payback period—the length of time it takes for the net present value of cost savings in the form of reduced waste recycling, treatment, or disposal costs (plus any other benefits, e.g., increased profits) to equal the cost of the new capital. In cases where modifying production results in recurring costs such as operation and maintenance expenses in excess of those before the modification, those costs must be balanced against the expected savings.

In other situations, the firm may be faced with increased expenditures on raw material inputs or labor, or the costs associated with training employees in the use of new procedures or processes. To the extent that the change results in less waste, increased productivity, or any of the other cost reductions described in the previous section, the firm

must compare the costs and benefits incurred. As long as the benefits exceed the costs, overall costs will be lower and it is in the firm's interest to adopt the strategy in question.⁴

Finally, firms may experience a decline in sales, and possibly profits, to the extent that waste reduction efforts result in reduced product quality. In addition, sales may decline if firms must increase prices to account for increased costs of production.

Consumers. Consumers may incur costs in the form of reduced product quality or a reduced range of choice as production processes are modified to reduce waste generation. Consumers may also incur costs as a result of changes that reduce the amount of convenience associated with the consumption of specific products. For example, conversion from styrofoam to paper packaging in the fast-food industry would reduce the "quality" of the product. This conversion, however, results in reduced emissions of chloro-fluorocarbons into the air and therefore constitutes waste reduction. In addition, product prices may increase as a result of waste reduction efforts that cause production costs to increase.

Society. Society may incur costs in the form of increased unemployment in some industrial sectors. Unemployment could result to the extent that production process changes lead to more capital-intensive processes or the production of specific goods is decreased or eliminated. Nonetheless, it is reasonable to expect that, over the long run, some or all of this unemployment would be offset by increases in employment in other sectors.

Government. Finally, government may expend considerable resources identifying the potential for waste reduction and appropriate policies to achieve waste reduction goals. Government may also incur costs to the extent that programs directed at waste reduction require that resources be expended on monitoring and enforcement. In addition, government agencies may rely on the use of education and technology transfer to facilitate waste reduction. Consequently, considerable resources may be expended to develop and administer programs for education, research, and technology transfer and technical assistance.

4.3.3.3 *Balancing the Benefits and Costs of Waste Reduction*

Table 4-1 summarizes the various benefits and costs of waste reduction that may be realized by affected parties. Given this information, we now return to the question:

⁴One problem in the past is that industry has not calculated the total cost of waste generation. In particular, many firms consider disposal costs but fail to consider the cost of lost raw materials, labor costs, downtime due to spills, etc.

“How much waste reduction should firms engage in?” (i.e., what is the socially efficient level of waste reduction?). As we indicated earlier, to maximize social welfare, waste reduction efforts should be engaged in to the point where the marginal social benefits equal marginal social costs. From a practical standpoint, however, fully implementing this concept is not possible.

Table 4-1. Potential Costs and Benefits of Waste Reduction

	Benefits	Costs
Industry	<ul style="list-style-type: none"> • Cost savings • Increased sales • Improved image 	<ul style="list-style-type: none"> • Increased production costs • Reduced product quality • Lost sales • Risk and uncertainty
Consumers	<ul style="list-style-type: none"> • Lower product prices • Improved product quality 	<ul style="list-style-type: none"> • Reduced choice • Reduced product quality • Increased prices
Society	<ul style="list-style-type: none"> • Improved environmental quality • Lower health risks • Increased employment 	<ul style="list-style-type: none"> • Unemployment in specific industries
Government	<ul style="list-style-type: none"> • Reduced expenditures on promulgation, monitoring, and enforcement of end-of-pipe regulations 	<ul style="list-style-type: none"> • Policy formulation • Monitoring and enforcement

Because many of the costs associated with waste recycling, treatment, and disposal are external to the firm, firms will not, in all likelihood, employ the economically efficient level of waste reduction on their own. Consequently, policymakers must intervene in the market. In many cases, however, attaching dollar values to some of the costs and benefits noted above will be extremely difficult, if not impossible. As such, it is highly unlikely that a particular policy will result in the economically efficient level of waste reduction. Nonetheless, the potential sources of benefits and costs listed in Table 4-1 should be used, at a minimum, in a qualitative fashion to assess the benefits and costs—both internal and external—of a particular option directed at increasing waste reduction efforts in the industrial sector.

4.3.4 Waste Reduction as an Input into the Production of Waste Management

As was noted above, in terms of environmental quality, waste reduction should be firms' preferred approach to managing industrial wastes. Nevertheless, viewing waste reduction in a broader context is necessary to correctly determine the socially efficient level of waste reduction that firms should undertake (i.e., the level of waste reduction where marginal social benefits equal marginal social costs). To be specific, waste is generated as part of a firm's production process. In the course of deciding how much output (and how much waste) it should produce, a firm needs to consider the relationship between the various inputs to the production process and the relative prices of those inputs. From the firm's perspective, waste management can be viewed as an output. In turn, waste reduction constitutes one of four inputs into the production of waste management. The other inputs are off-site recycling, treatment, and disposal. (Of course, a number of specific options are included under each of these broadly defined headings.)

From the firm's perspective, waste management (or any other output) is produced at least cost when the marginal (additional) product for the last dollar spent on each input is equal across all inputs. Marginal product refers to the contribution to total output made by the last unit of input employed. Note that in some cases one or more of the inputs to waste management may be unavailable for a particular waste. For example, some wastes cannot be treated in any way, and other wastes are banned from land disposal.

As an illustration of producing waste management at least cost, consider the case where a firm has two options for managing its waste—reduction and disposal in a landfill. Assume that the per-unit cost of waste reduction increases as the firm increases its waste reduction and that the initial unit of waste reduction costs less than the initial unit of landfilling.⁵ In this case the firm should engage in waste reduction efforts up to the point where the cost of the last unit of waste reduced is just equal to the per-unit price of land disposal. By engaging in this level of waste reduction, the firm will minimize the costs of waste management.

4.3.5 Prices of Waste Management Inputs and the Incentives Effects on Industry

It was noted above that externalities associated with the generation and disposal of both hazardous and nonhazardous wastes have imposed considerable costs on society, primarily because firms generally have not been required to pay the social (private plus

⁵It is assumed that the price of landfill disposal reflects both internal and external costs (i.e., it is the socially efficient price).

external) cost of waste disposal. In particular, land disposal fees have been considerably less than the true social cost of land disposal. Historically, land disposal fees have reflected only the out-of-pocket expenses associated with the transport and burial of the waste and the land in which it is buried. Generally speaking, the same has been true of alternative treatment options such as incineration.

The relative prices of inputs create incentives for firms to choose one mix of inputs over all others when selecting a particular production process—in this case the process by which wastes are managed. To the extent that waste disposal prices do not reflect the social cost, firms have the incentive to employ an amount of land disposal that is in excess of the socially efficient amount of land disposal. This is because the price of land disposal relative to the prices of the other inputs to the production of waste management is too low. Hence, firms have employed too much land disposal and too little waste reduction in their production of waste management. Establishing socially efficient prices would address this problem directly.

4.4 BARRIERS TO WASTE REDUCTION

Previous studies (OTA, 1986; National Research Council, 1985) have identified at least three barriers to effective waste reduction, including (1) a lack of information and technical ability, (2) the existing regulatory framework, and (3) technological obstacles. These three broad headings can include the following items:

- simple inertia;
- incorrect prices for alternative waste management options;
- uncertainty about the effectiveness of particular strategies;
- regulations that focus the attention of firms on end-of-pipe compliance;
- the effects of existing regulations that mandate specific treatment or control technologies that generate specific wastes; and
- cost considerations and the effects of potential waste reduction on the competitive position of the firm.

4.4.1 Lack of Information and Technical Ability

4.4.1.1 Information

To be able to adopt effective waste reduction techniques, a firm must possess a clear and detailed understanding of the types and quantities of wastes it generates, the specific sources of those wastes within the production process, and the available waste

reduction techniques that it could employ. Unfortunately, many firms lack this information.⁶ In addition, from the perspective of society, firms will engage in the socially efficient level of waste management only if each input to the production of waste management is priced on the basis of its social cost.

On a related note, individuals within firms sometimes lack information regarding the corporate policy with respect to waste reduction. If individuals are unaware that the firm is actively committed to waste reduction, they may not devote scarce resources to such efforts. Consequently, it is important that any policy regarding waste reduction be disseminated to all affected individuals.

4.4.1.2 *Risk and Uncertainty*

Many firms also lack information concerning the cost and effectiveness of waste reduction techniques. This lack of information creates uncertainty that may inhibit plant managers, keeping them from adopting specific strategies. In addition, there is often uncertainty regarding the effect on product quality of a change in the production process or product design. In particular, firms may be uncertain as to how customers will react to changes in specific products. Because of this uncertainty firms may expect to incur higher costs, further constraining their adoption of possible waste reduction techniques.

4.4.1.3 *Technical Ability*

Many smaller firms lack the technical ability to interpret and apply, in their own plants, waste reduction techniques and technology previously applied successfully by other, larger firms. Often the technical person in a small plant serves multiple roles and has insufficient time to even monitor the relevant literature. This problem is exacerbated in industries such as the construction industry that do not have a major trade association to sponsor research relevant to specific industry needs and disseminate the results of this research. To effectively evaluate waste reduction opportunities, a small firm can often benefit from outside help. Such help may be available from state agencies with information exchange responsibilities or from consultants. Unfortunately, very small firms may not have the financial means to hire consultants.

⁶This fact is, in turn, a strong argument for the requirement that all firms conduct periodic waste reduction audits.

4.4.1.4 *Inertia*

In many instances, inertia on the part of management and employees has been found to be one of the biggest obstacles to adopting waste reduction strategies. Even in cases where the pay-back period is relatively short and the benefits appear to be certain, firms are often reluctant to engage in waste reduction. This problem stems partly from the general reluctance on the part of many individuals to depart from the status quo. It may also reflect lingering uncertainties about the total effects of waste reduction efforts on costs, product quality, and the firm's competitive position in the market. In such cases, enhanced technology transfer may be the best solution.

4.4.2 Existing Regulatory Framework

4.4.2.1 *Regulations Governing End-of-Pipe Treatment*

OTA's (1986) analysis of waste reduction placed considerable emphasis on the historical tendency of regulatory agencies to focus on pollution control as opposed to pollution prevention. This emphasis has led firms to devote the majority of their efforts regarding pollution to achieving compliance with end-of-pipe standards rather than reducing generation of the waste in question. Because all firms are faced with resource constraints, it is likely that the current regulatory approach has had a negative effect on waste reduction initiatives.

Any policy designed to achieve significant waste reduction must recognize the ingrained behavioral tendency of most firms toward an emphasis on end-of-pipe approaches to waste management. As OTA has suggested, it may be necessary to offer incentives to firms in the form of trade-offs between efforts to achieve waste reduction and efforts to comply with existing end-of-pipe regulations. To be specific, it might be advisable to grant variances from some existing regulations to firms that are in the process of developing and implementing specific waste reduction strategies. This approach recognizes the resource constraint that almost all firms face when attempting to simultaneously achieve the goals of maximizing profit and improving environmental quality. The Illinois Toxic Pollution Prevention Act incorporated this approach (see Section 2.5.1.3).

4.4.2.2 *Conflicting Regulations*

In some cases, complying with existing regulations causes firms to generate increased amounts of waste. In some instances, waste reduction is not possible without a

significant change in the production process or the regulations in question. The following examples illustrate the types of problems that may arise in this regard.

Stack Scrubbers on Coal-fired Heat and Power Plants. Emissions regulations have been established to reduce sulfur oxide emissions into the atmosphere. An existing plant can comply with regulations by burning low sulfur coal or by scrubbing the flue gas with a reactive solution that absorbs the sulfur oxides and converts them to insoluble material that requires landfill disposal. Because of inefficiencies in the scrubbing process not all of the reactant in the scrubber mixture is consumed, thus adding to the overall amount of waste requiring disposal. This problem is exacerbated for planned new sources. New Source Performance Standards require flue gas cleaning even in those instances where low sulfur coal is contemplated as the fuel, again increasing the total amount of waste requiring disposal.

Wastewater Treatment. In many instances, land treatment techniques are used to treat municipal wastewater. One example is nitrification-denitrification. These tertiary steps often require promoting the growth of specific bacteria, which ultimately contribute to an increased volume of sludge requiring disposal.

Land Disposal Bans for Hazardous Waste. A progression of regulatory bans have been issued that prohibit land disposal of certain categories of hazardous waste. These bans proscribe land disposal unless specifically approved treatment is applied to reduce the concentration of particular hazardous constituents to acceptable levels. The treatment steps in many of these prescribed treatment methods can create greater amounts of waste than originally required disposal.

4.4.3 Technological Obstacles

In contrast to the problem of a lack of technical ability, which refers to inadequacies that prevent the adoption of existing technologies, situations exist where waste reduction is not possible given the current level of available technology.

4.4.3.1 Economies of Scale

In certain instances, specific waste reduction techniques may be uneconomical for the firm as a result of “economies of scale” in waste reduction. The term “economies of scale” refers to the situation in which the average total costs of production decrease as the scale (i.e., size) of the operation increases. When waste reduction options are

characterized by significant economies of scale, using those options may not be cost-effective for small firms. For example, for some wastes, recycling within the production process may only be cost-effective when the amount of waste recycled exceeds some threshold level. If the level of output produced by the firm is not sufficient to meet or exceed this threshold, the recycling option is not cost-effective.

4.4.3.2 *Nature of the Industrial Process*

Depending on the output produced by a particular industry, the frequency of the changes in product design/formulation, the nature of the inputs employed, and outside forces (e.g., contractual arrangements specifying particular production processes or inputs) industries may be more or less able to engage in specific waste reduction strategies. For example, some industries, such as the pharmaceuticals industry, produce very sophisticated products that require very precise production processes and inputs. In an industry with these characteristics, the potential for waste reduction is limited primarily to operations changes. The same is true for industries that produce products for agencies such as the Department of Defense (DOD). DOD contracts usually specify particular production processes and inputs to ensure product quality. (It is important to note, however, that DOD is presently working on modifying some of its military specifications to accommodate waste reduction alternatives.)

On the other hand, industries that produce goods that are frequently redesigned offer a much greater potential for adopting a wide range of waste reduction strategies. These industries include consumer goods industries, those that process many different industrial products, and those that produce frequently changing high-tech products for industrial use including electronic components and medical equipment. Possible waste reduction options include operations changes, process changes, in-process recycling, input substitution, and end-product changes (OTA, 1986).

4.5 SUMMARY

This chapter has examined the technical and economic aspects of waste reduction, as well as potential barriers to increased waste reduction efforts in the industrial sector. Firms can use a number of different techniques to reduce their waste generation. Determining which techniques are most applicable depends on the technical aspects of the firm's production process and the costs and benefits of adopting a specific technique.

From an economic perspective, waste reduction should progress up to the point where the marginal social benefits equal the marginal social costs of waste reduction. From society's perspective, however, other factors such as equity must also be considered. Because many of the costs and benefits associated with waste reduction are external to the firm, public policy should play an important role in encouraging waste reduction. In addition, public policy should be directed at reducing or eliminating the existing barriers to waste reduction.

REFERENCES

- Brown, J. S. 1987. *Process Modification and Pretreatment Changes for Waste Reduction*. Marshall, IL: Velsicol Chemical Corporation.
- California Department of Health Services. 1988. *Economic Implications of Waste Reduction, Recycling, Treatment and Disposal of Hazardous Wastes—The Fourth Biennial Report*.
- Donahue, B. A., D. Sarver, and E. Bellino. 1986. *Field Test of Life Cycle Cost Analysis for Solvent Management*. U.S. Army Construction Engineering Research Laboratory, Champaign, IL.
- Kneese, A. V. and B. T. Bower. 1979. *Environmental Quality and Residuals Management*. Resources for the Future. Baltimore, MD: John Hopkins University Press.
- Kraybill, D.D., S. Mehta, and D. Thomas. 1989. "Waste Reduction Case Histories: What's Worked, What Hasn't, and Why." *Proceedings of the Second Annual Hazardous Materials Management Conference/Central*, March 14-16, 1989.
- Mitre Corporation. 1989. *Pollution Prevention in the Federal Sector*. McLean, VA.
- National Research Council. 1985. *Reducing Hazardous Waste Generation*. Washington, DC: National Academy Press.
- Office of Technology Assessment. 1986. *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency*. OTA-ITE-317. Washington, DC.
- Personal communication. 1989. Mikucki, W., Mikucki and Associates, Champaign, IL, with Scola, P.E., U.S. Army Production Base Modernization Activity.
- Research Triangle Institute. 1989. *Alternatives for Measuring Hazardous Waste Reduction: Final Report*. Savoy, IL: Hazardous Waste Research and Information Center.
- U.S. Environmental Protection Agency. 1988. *The EPA Manual for Waste Minimization Opportunity Assessments*. EPA/600/2-88-025. Washington, DC.

CHAPTER 5

ANALYSIS OF POLICY OPTIONS FOR PROMOTING INDUSTRIAL WASTE REDUCTION

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CHAPTER 5

ANALYSIS OF POLICY OPTIONS FOR PROMOTING INDUSTRIAL WASTE REDUCTION

5.1 OVERVIEW

The goal of environmental policy is to protect and improve environmental quality and human health and welfare. To this end, Illinois has identified a number of policy objectives and incorporated them into legislation. These objectives include (but are not limited to) reducing the quantity of wastes that are generated in production and consumption processes; developing improved methods of waste recycling, treatment, and disposal; and remediating leaking disposal sites. For each objective, a variety of policy options could be implemented. The purpose of this chapter is to identify and assess the policy options available to achieve the objective of waste reduction. In Chapter 6, we use the results of this analysis to evaluate the potential effectiveness of these policy options for Illinois in light of Illinois' industrial structure.

5.2 DESCRIPTION OF POLICY OPTIONS

As discussed in the previous chapter, society's waste problem is, in large part, the result of firms not considering externalities, such as the risks associated with the management of wastes, when making production decisions. In the past, firms have faced a set of prices for the various waste management options that do not reflect their true social cost. As a result, waste management has been produced inefficiently. The challenge for policymakers is to develop a strategy (or set of strategies) that forces waste generators to internalize the external costs (and benefits) of each waste management option. To the extent that policymakers are successful in their efforts, firms will engage in the efficient level of waste reduction.

A variety of policy options are available to encourage adoption of waste reduction in the industrial sector. These options can be grouped under three broad headings:

- direct regulation,
- economic incentives, and
- voluntary compliance and education programs.

In the next few sections, we examine options within each of these three categories and provide specific examples of how each option could be used. It is important to note that although specific policy options fall under a single heading, a well-structured strategy will in all likelihood draw from all three categories.

5.2.1 Direct Regulation

Historically, direct regulation has constituted the dominant approach employed by federal and state policymakers to achieve improvements in environmental quality. Often referred to as the “command and control” approach, direct regulation may, for example, require firms to use a particular production process or one that achieves a specified level of performance, reduce emissions or effluents to specified levels, or otherwise meet specific design or performance criteria. In addition, direct regulation generally requires that all affected firms meet the same criteria (e.g., keep emissions of a particular air pollutant below some threshold level).

There is an important distinction between direct regulations that specify design criteria and regulations that specify performance criteria. Design criteria specify technologies, inputs, chemical processes, and so forth that must be employed by affected firms. In contrast, performance criteria specify a necessary end result that can be achieved by any means—presently available or yet to be developed—available to the firm. Performance criteria offer significant advantages relative to design criteria, especially when dealing with complex production processes. In particular, performance standards allow and encourage firms to innovate in the effort to achieve a particular standard at least cost.

In the context of waste disposal, the U.S. Environmental Protection Agency (USEPA) has used direct regulation to establish minimum performance and design criteria for treatment and disposal facilities (e.g., destruction rates for incineration and design characteristics for landfills). Direct regulation has also been used to establish reporting guidelines and handling, transport, treatment, and disposal requirements for hazardous waste generators and treatment, storage, disposal, and recycling facilities.

A number of options that could be used to encourage waste reduction fall under the heading of direct regulation. These options include

- mandatory waste reduction audits followed by the formulation of specific waste management plans,
- mandatory performance standards for certain production processes,

- mandatory percentage reductions in waste generation per year,
- bans on certain inputs or outputs, and
- bans on the use of certain treatment or disposal options.

5.2.1.1 Mandatory Waste Reduction Audits and Facility Plans

Many firms do not have complete knowledge of the types and quantities of wastes they generate. This is especially true of large firms that produce multiple outputs. As such, for most firms, waste reduction audits and facility plans are necessary precursors to successful waste reduction efforts. Audits provide the information required to assess the extent of the waste problem, identify specific areas where waste reduction efforts might provide the greatest benefit, and monitor the progress of waste reduction efforts. Facility plans must be developed to implement specific waste reduction strategies identified by the audit. To ensure that they are conducted, waste reduction audits and plans could be made mandatory for all production facilities. An example of a waste reduction audit format is included in Appendix B of this report.

It was noted in Chapter 4 (Section 4.2.1), that waste reduction audits provide a direct means for policymakers to assess the progress of waste reduction efforts. From the regulatory authority's perspective, audits should be certified by neutral, professional third parties to ensure the quality of the audit. In addition, decisions would have to be made regarding how to handle proprietary information and public information in the audit.

Audits provide information required to effectively address waste reduction; however, audits and facility plans also impose additional costs on industry. To successfully complete a waste audit, a firm needs to devote considerable resources, primarily labor, to monitoring each stage in its production process to identify all of the types and quantities of wastes generated. In addition, it is important that all employees be made aware of the firm's objective so that all of the information necessary to complete the audit is made available to the individuals responsible for conducting the audit. Although cost should not be the sole decision criterion, it nevertheless is an important consideration in view of the resource (budget) constraint faced by most production facilities.¹

5.2.1.2 Mandatory Performance Standards

Policymakers also have the option of imposing mandatory performance standards on industries as a means of achieving waste reduction targets. Performance standards

¹The estimated cost for a consultant to conduct this assessment at a larger industrial facility is approximately \$20,000 (USEPA, 1988).

have been used extensively in the areas of air and water pollution. The requirement that publicly owned treatment works use best conventional technologies and the requirement of reasonably available control technologies to control volatile organic compounds (VOC) emissions and therefore ozone formation are just two examples.

As part of its implementation of the Hazardous and Solid Waste Amendments of 1984 (HSWA), USEPA has also begun specifying best demonstrated available technologies (BDAT) as a means of establishing pretreatment standards for the land disposal of hazardous wastes. Although firms are not required to use the specific technologies identified by USEPA, they must nonetheless meet the treatment standards associated with the BDAT or they will be unable to dispose of their wastes in landfills.

Similar standards could be developed for specific production processes in selected industries; a regulatory agency could identify, for example, the best available production process (BAPP) for the production of a particular output. The BAPP would be used to establish upper limits on waste generation rates (e.g., the amount of waste generated per unit of output). Firms would have to employ a production process that produced an amount of wastes that did not exceed that associated with the BAPP for the industry. Relative to a design criterion, a BAPP—which is a performance criterion—has the advantage of allowing firms to employ or develop whatever method allows them to achieve the standard at least cost.

The major problem with establishing performance standards is the amount of information about specific production processes that would be required to develop defensible standards. Standards would have to be developed for individual processes within individual industries. The Regulatory authority would expend significant resources and time to establish these standards.

5.2.1.3 Mandatory Percentage Reductions in Waste Generation

One of the most direct methods of forcing waste reduction, short of bans on the generation of specific wastes, consists of mandatory percentage reductions in the amount of wastes generated. Such a restriction could be based on the absolute change in the quantity of waste generated (ABS) or on the adjusted change in the quantity of waste generated (ADJ). ADJ adjusts the change in the quantity of waste generated to reflect changes in production or business activity (see Section 3.2.2).

An important shortcoming of the ABS approach is that it fails to account for changes in the level of production in the economy. In the event of a recession and a decrease in output, waste generation will automatically decrease. This decline would incorrectly indicate that the policy was having some success. On the other hand, increases in production resulting from a robust economy would, all else constant, lead to an increase in the total amount of waste generated. In this case, the ABS approach might incorrectly conclude that waste reduction efforts had failed. To be specific, waste generation rates may have declined even though the total amount of waste generated had increased (due to the increase in total output).

Although the ADJ approach does consider changes in economic activity, there are many other factors that affect waste generation that ADJ does not address. For example, waste generation may vary greatly due to changes in operating conditions (e.g., weather conditions, throughput rates), a factor not considered under the ADJ approach.

A mandatory percentage reduction may not be attainable for some firms. A firm may have already exhausted all of its opportunities for reducing waste. Differences (e.g., age of equipment, quality of product) among production facilities within a given industry may also prevent certain firms from achieving a particular target. Developing reduction rates that consider all these variations would require significant resources and may not be possible due to data limitations, as discussed in Chapter 3. In addition, the lack of available data on waste generation and management practices will create serious impediments to monitoring firm behavior and enforcing waste reduction targets.

5.2.1.4 Banning Certain Chemicals, Products, and Management Practices

As part of proposed model legislation, the National Campaign Against Toxic Hazards has suggested granting specific regulatory agencies the authority to

ban the production, sale, use, or disposal of any toxic material or the use of a specific production process or operation whenever the program determines (i) that there are safe, reliable and economically feasible substitute materials or processes, or (ii) that continued reliance upon a specific toxic material, production process or operation poses unacceptable risks to human health and the environment (Allen, p.8).

Obviously, bans constitute the most direct means of reducing the quantities of specific wastes that are generated. Bans have been used in the past as a means of improving environmental quality. For example, in 1974 USEPA suspended the

registrations of two pesticides, Aldrin and Dieldrin, on the basis of evidence that these pesticides presented an “imminent hazard” to the public.

In spite of the directness of this approach, however, it has several drawbacks. In particular, it is difficult to establish that a specific product, input, or production process poses so serious a threat to public health and the environment that its outright ban is justified. In addition, there is the possibility that the substitute materials and their waste products may constitute an even greater threat than the materials they replaced. Finally, bans on certain products, inputs, or management practices may result in outcomes that are economically inefficient from society’s perspective. This would occur if the ban forced industry to curtail the production of a particular good, even though the economically efficient level of output is greater than zero.

Bans on certain waste disposal practices have been employed in the effort to reduce the risks to human health and the environment posed by hazardous wastes. One of the stated objectives of HSWA was to minimize “the generation of hazardous waste and the land disposal of hazardous waste.” To this end, Congress included a series of provisions in HSWA requiring USEPA to ban, to the extent possible, the land disposal of individual hazardous wastes. In addition, USEPA was directed to establish treatment standards for wastes for which there are no practical alternatives to land disposal.

In a similar manner, Section 39(h) of the Illinois Environmental Protection Act prohibits the land disposal of hazardous wastes unless the generator of the waste can show that there are no economically reasonable or technologically feasible treatment alternatives that would render the waste either less hazardous or nonhazardous. The major problem with bans of this type is that they may simply shift the waste to another medium, e.g., water or air, rather than reduce the amount of the waste that is produced. There is also the possibility of an economically inefficient outcome as discussed above.

5.2.1.5 Additional Options

In addition to the specific options discussed in the preceding sections, policymakers could institute requirements that fall within the existing regulatory framework. For example, legislation could impose mandatory product labeling requirements on certain industries requiring disclosure of the nature of the inputs used and their environmental consequences. Mandatory product labeling would enable consumers to choose products on the basis of their environmental impacts and might

create incentives for firms to engage in waste reduction efforts to improve the environmental image of their products.

Policymakers could also lower concentration thresholds for allowable emissions and effluents of specific pollutants. Lowering concentration thresholds might reduce the cost of waste reduction relative to generating and treating the waste to acceptable levels. Care must be taken, however, to ensure that facilities are not diluting the waste to achieve the new threshold or shifting it to another medium.

5.2.2 Economic Incentives

Each firm must decide how much output to produce, how to manage wastes generated in the production process and, implicitly, how much waste it will generate. These decisions are based on the firm's output prices and the relative prices of the inputs to the production process, including the various waste management options. Consequently, it is important that all input prices reflect the true social costs of their use. This is especially true for waste management alternatives. Economists have consistently argued for the use of economic-based policy instruments to force firms to internalize otherwise negative externalities and, consequently, bring about improvements in environmental quality. The major options include

- taxes,
- transferable discharge permits,
- subsidies, and
- fines.

5.2.2.1 Taxes

One way to force firms to account for the externalities they generate is to impose a tax on the firm equal to the external cost of the firm's waste production activities. Taxes affect the firm's waste management and production decisions by altering the relative prices of waste management options faced by the firm or the relative prices confronting consumers. For example, waste generators could be required to pay a per-unit tax on each unit of waste generated.

In a similar fashion, a tax could be based on each unit of waste managed in a particular manner. Many states and the federal government already use variations of each of these types of taxes, primarily to fund clean-up programs such as the Superfund. As we discuss in detail in Section 5.3.3, the effectiveness of this approach will depend on the

elasticity (i.e., responsiveness of the firm's demand for the waste management option to a change in price). The more price elastic demand is, the more effective the tax will be.

Excise taxes could also be used to alter the types and quantities of waste generated by industry. For example, an excise tax could be imposed on products that are determined to be "toxic producing" in the sense that their production leads to the generation of hazardous wastes. Such a tax would have the effect of increasing the price paid by consumers. Consequently, the quantity demanded would decrease and the equilibrium level of production would decline (along with the quantity of waste generated). There are at least two drawbacks associated with this type of tax. From an efficiency perspective, the tax is not linked directly to waste generation. Hence, it has only an indirect effect on waste reduction. In addition, if the demand for the product is insensitive to price changes, the tax will have little or no effect on output because the producer can simply pass the tax on to the consumer.

One of the attractive side benefits of using taxes is the revenues that they generate. These revenues could be used to help defray the costs of specific programs directed at waste reduction. It is important to recognize, however, that depending on the type of tax used, and its effectiveness, revenues may decline over time. This would be the case for per-unit taxes imposed on specific wastes and excise taxes.

5.2.2.2 Transferable Discharge Permits

A system of transferable discharge permits (TDPs) entails issuing a fixed number of permits to emit a particular pollutant in a given geographic region. These permits can then be traded among affected firms. The price at which the permits are traded is determined by the forces of supply and demand. In the case of waste reduction, a fixed number of permits could be issued that would allow the holder of the permit to generate the amount of waste specified by the permits. Alternatively, permits could govern the amount of specific wastes that are managed in a particular way (e.g., the regulatory authority could issue permits governing the landfill disposal of a specific waste), but this option only indirectly encourages waste reduction.

TDPs have a number of attractive features and have been used to control specific pollutants. It is important to note, however, that TDPs cannot be used to identify the socially efficient level of pollution. Rather, their attractiveness lies in their ability to ensure that a given reduction in pollution is achieved at least cost. This issue is discussed in more detail in Section 5.3.1.1.

In the context of waste reduction, TDPs also suffer from the drawback of, in effect, establishing an “acceptable” level of waste generation. (Note that this is true with any standards-based approach.) Consequently, firms may have less of an incentive to pursue waste reduction efforts beyond the legally established threshold.

5.2.2.3 Subsidies

Various analysts have proposed the use of subsidies as a means of encouraging waste reduction efforts by industry. Subsidies can take a variety of forms including direct payments, grants, and low-interest loans. For example, subsidies in the form of research grants could be used to fund research on new production techniques and processes and the development of new production processes or modifications to production processes that result in waste reduction. In addition, subsidies in the form of direct payments or low-interest loans could be used to assist firms in adopting waste reduction strategies by sharing some of the cost of options such as the modification of existing capital equipment and the installation of new capital equipment. As discussed below, however, subsidies have some undesirable properties with respect to economic efficiency and equity. In addition, the effect of subsidies on the actual amount of waste generated is not clear *a priori*.

Varying tax rates, such as the corporate income taxes paid by firms, could also be used to alter firm behavior. For example, firms that can document successful efforts to reduce wastes through innovative capital equipment improvements could be offered an investment tax credit. The tax credit amounts to a subsidy to the firm because its overall tax bill is diminished relative to identical firms that do not invest in the new capital. More generally, corporate tax rates could be adjusted down (up) to reward (punish) firms that engage (don’t engage) in substantive waste reduction efforts.

The use of tax rates has at least four major drawbacks. First, investment tax credits are directed at reducing costs that firms ordinarily might not consider undertaking. As such, firms may nonetheless view the potential investment as an additional cost of production that does not contribute to increased output. Second, monitoring the performance of individual firms as part of the administration of a variable corporate tax scheme would be extremely difficult. Third, firms may not view the potential tax savings as worth the cost of investigating potential waste reduction strategies. Fourth, the tax credit may create an incentive for inefficient behavior. In particular, firms may be induced to invest in waste reduction techniques that are less efficient than alternatives not

covered by the investment tax credit. Consequently, the incentive effect of providing investment tax credits and altering corporate tax structures may be less than that of imposing taxes on specific wastes.

5.2.2.4 Fines

Fines serve more as an enforcement mechanism than as a direct incentive to reduce wastes. Nonetheless, imposing fines on firms that fail to comply with specific mandates (e.g., regulations or bans) creates an incentive for compliance by the affected firms. The effectiveness of the fine will depend on the probability that the fine will be levied on the firm and the magnitude of the fine (i.e., its expected cost). The expected cost of the fine is also affected by the potential legal fees a firm would incur in litigation concerning actions covered by the fine.

5.2.3 Voluntary Compliance Programs

In Chapter 4 (Section 4.4.1) we noted that one of the main barriers to waste reduction is firms' lack of information regarding available waste reduction strategies. In many cases, it is reasonable to assume that firms have not done more to reduce the amount of wastes they generate simply because they are unaware of available waste reduction options. For the state's waste reduction program to be successful, the state must provide to industry all available information regarding waste reduction options.

The potential exists for significant technological advances with respect to waste reduction techniques at the industry and firm level. Consequently, there is a need for additional research into the opportunities for waste reduction in specific situations. Research and development efforts are costly, however, and the benefits to the individual firm may be outweighed by the costs. Therefore, a program designed to facilitate research and development is an important part of an overall waste reduction strategy.

A number of options are available that rely on nonregulatory approaches by government to encourage voluntary efforts by industry to reduce the amount of wastes generated. These options can be grouped together under the following headings:

- research and development;
- education, technology transfer, and technical assistance; and
- positive incentives.

5.2.3.1 *Research and Development*

Rather than simply establishing standards to be met by firms, government could actively support research on issues related to waste reduction. In fact, Illinois already has addressed this issue by creating the Hazardous Waste Research and Information Center (HWRIC). HWRIC assumes the dual role of both a source of information and a sponsor of research undertaken by academic institutions and other research-related organizations.

The Center for Solid Waste Management Research, located at the University of Illinois at Urbana-Champaign, is an example of the role cooperative research can play in dealing with industry's waste problems. The Center funds research on a number of different topics, ranging from the technological to the sociological aspects of waste management. The results of this research are an important contribution to efforts designed to manage wastes more effectively.

Publicly funded research has the potential to make a significant contribution to the goal of waste reduction. Research and development is generally considered a risky and costly undertaking. In many cases, the resources of firms are not sufficient to support research on methods that could be employed by the firm to reduce waste. This is especially true of very small firms that operate in competitive markets. In these cases research will most likely have to be funded by outside individuals such as the public sector.

5.2.3.2 *Education, Technology Transfer, and Technical Assistance*

At a general level, educational programs serve a useful purpose by informing industry, policymakers, and the general public about the benefits of waste reduction. Education programs can be used to accomplish a number of tasks including

- explaining the importance of waste reduction to society,
- defining what waste reduction is (and what it is not),
- informing individuals about the broadly defined waste reduction techniques that are available, and
- informing individuals about the availability of information concerning waste reduction.

Education programs can also serve as a vehicle for demonstrating to firms the potential savings to be realized from the adoption of waste reduction strategies.

The term “technology transfer” refers to the process of disseminating new information regarding technological innovations to the potential users of that information. Consequently, technology transfer amounts to the development of education programs designed to increase industry’s awareness and understanding of specific waste reduction techniques that are currently available. In addition, these programs provide firms with information concerning how they can procure technical assistance in their waste reduction efforts. Training programs are useful to demonstrate how waste audits are performed and how specific waste reduction techniques can be employed within specific industries and firms.

A comprehensive technology transfer and technical assistance program should be designed to achieve the following objectives:²

- stimulate the use of waste reduction audits in all waste-generating activities;
- disseminate technical, legislative, programmatic, and statistical information on waste reduction to various groups;
- provide technical assistance to state and local agencies, industries, and citizens in implementing waste reduction efforts; and
- support general and industry-specific information exchange via conferences and seminars.

Developing an effective technology transfer program requires identifying the data that are needed with respect to specific industries, production processes, outputs, and the target audience.

HWRIC already performs many of the functions described above. For example, HWRIC’s Waste Reduction Advisory System is a computerized checklist and information bibliography designed to accomplish technology transfer within the industrial sector. The system has been successful and is being expanded. HWRIC also supports research and development, as well as conferences, seminars, and workshops; however, HWRIC’s ability to engage in these activities is limited by its staff size and resources.

5.2.3.3 Positive Incentives

Positive incentives include options such as public recognition of significant waste reduction efforts by individual firms and the use of awards (e.g., cash) to recognize

²This list is adapted from a draft report on pollution prevention that is currently being developed by the USEPA.

achievements with respect to waste reduction. Such recognition serves to bolster the firm's public image. As discussed in Chapter 4 (Section 4.3.3.1), an improved public image may in turn lead to increased sales and, possibly profits, for the firm.

For the past four years HWRIC has administered the Governor's Pollution Prevention Awards (formerly designated the Innovative Waste Reduction Awards). These awards are issued in four separate categories: large businesses, small businesses, community organizations, and educational institutions. The awards are designed to encourage waste reduction in all sectors of the economy by recognizing outstanding efforts by individual entities. Experience with the program indicates that it does generate positive incentives for waste reduction efforts and constitutes an important element in a comprehensive strategy to encourage waste reduction.

As an additional positive incentive, the state could encourage waste reduction by example. State agencies already encourage recycling of postconsumer wastes such as paper. This approach could be expanded to other waste-generating activities as well. To be specific, state agencies, state-supported educational institutions, and so forth, could develop and implement specific waste reduction plans. These practices would serve as real-world examples of some of the types of actions that industry can adopt in its waste reduction efforts.

5.3 EVALUATION OF POLICY OPTIONS

A wide array of policy options could be used to achieve the objective of waste reduction in the industrial sector. Each of the policy options discussed above possesses both positive and negative characteristics and the policy options vary with respect to their desirability, feasibility and acceptability, and effectiveness. Consequently, policymakers must make trade-offs when formulating a particular policy strategy. The following discussion is intended to highlight those trade-offs.

5.3.1 Desirability

In this study, the desirability of a particular policy option is assessed on the basis of two factors—efficiency and equity. (In this discussion, efficiency is evaluated in terms of net social benefits³ as opposed to, for example, the productive efficiency of the firm.) In many instances, there is a trade-off between efficiency and equity. Nonetheless, both

³Net social benefits are measured as the difference between total social benefits and total social costs (see Chapter 4, Section 4.3.2). Actions that cause marginal social benefits to increase by more than the increase in marginal social costs lead to an increase in net social welfare.

of these factors are important considerations in assessing the relative strengths and weaknesses of alternative policy options.

5.3.1.1 Efficiency

From society's perspective, the economically efficient outcome of a particular action is that which maximizes the net benefits of the action to all of society. With respect to waste reduction, economic efficiency is achieved when each firm that generates wastes engages in waste reduction efforts up to the point where the marginal social benefits are equal to the marginal social costs incurred. However, this outcome is generally not attainable given the lack of data on many of the costs and benefits of waste reduction.

The problems of insufficient, inadequate, and unreliable data typify the universe of pollution problems addressed by policymakers. Policymakers have responded to these problems by opting to establish standards for many pollutants (e.g., threshold emission or effluent levels) rather than attempt to identify the economically efficient level of each pollutant.

Using standards (e.g., waste reduction targets by industry or waste stream) is one possible approach to achieving the goal of waste reduction in the industrial sector. A number of states are already using standards in their efforts to reduce waste generation and disposal. For example, some states have established target percentage reductions in waste disposal that are to be achieved by some specified date. Mandatory performance standards for certain production processes and mandatory percentage reductions in waste generation per year also constitute specific standards. In the discussion that follows, the concept of a standard is used to illustrate the relative effects of alternative policy options with respect to efficiency. The approach is used only to illustrate these effects and is not intended to be an argument for the use of standards *per se*.

Although establishing a standard circumvents the problem of identifying the efficient solution—that is, the optimal amount of pollution reduction—the question of how to achieve the standard is left unresolved. Any one (or combination) of the policy options discussed in the previous section could be employed. From the perspective of efficiency, however, the objective is to identify the policy option that achieves the standard at least cost.

For a particular standard to be met at least cost, the marginal costs of compliance must be equal across all affected firms. A simple example, which is taken from Tietenberg (1988), can be used to illustrate this point. Assume that a standard is set that requires reducing by ten units the aggregate amount of waste that is generated per time period. Figure 5-1 depicts the marginal costs of waste reduction incurred by two different firms—A and B—that produce the waste in question. Marginal cost is measured on the vertical axis and waste reduction is measured on the horizontal axis. The amount of waste reduction undertaken by Firm A is measured moving from left to right. Firm B's waste reduction is measured moving from right to left.

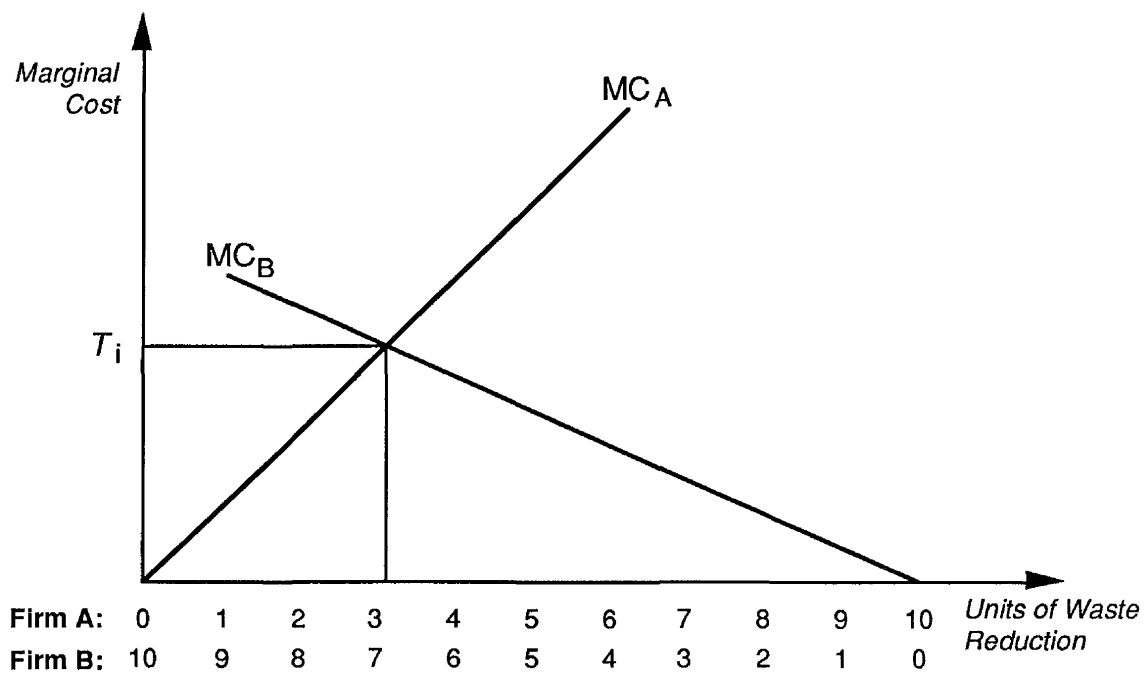


Figure 5-1. Marginal costs of waste reduction incurred by two firms.

Consider first the effect of a policy that requires each firm to reduce waste generation by the same amount—in this case five units—to achieve the standard. As the marginal cost curves are drawn, the firms incur different marginal costs of waste reduction—the marginal cost of the fifth unit of waste reduction for Firm A is greater than the marginal cost incurred by Firm B. The total costs of waste reduction are measured as the sum of the area under each firm's marginal cost curves between zero and five units of waste reduction.

Note in Figure 5-1 that the firms' marginal costs of waste reduction are equal when Firm A reduces its waste by three units and Firm B reduces its waste by seven units. In this case, total costs are lower than they are when firms are required to reduce wastes by the same amount. In fact, the total costs of waste reduction are minimized at this point. A deviation in either direction—for example, to an equal reduction of five units by each firm—would increase the marginal costs incurred by one firm by more than the reduction in marginal costs that is experienced by the other firm. As a result, total costs would increase.

To achieve the cost-effective result, policymakers could attempt to ascertain the marginal costs of waste reduction for all firms and then impose a standard on each firm that achieves the cost-effective outcome. This approach requires substantial data that are in all likelihood not available to regulators. As an alternative to firm-specific standards, the regulatory authority could impose a per-unit tax on the waste generated by each firm. Setting the tax at the level where the firms' marginal control costs are equal, at T1 in Figure 5-1, would reduce waste generation by ten units. Firm A would reduce waste generation by three units since the marginal cost of control is less than the tax on the first three units of waste. However, paying the tax is cheaper than reducing waste beyond three units. Using the same logic, Firm B would choose to reduce the amount of waste it generates by seven units.

Although, theoretically, taxes are more cost-effective than direct regulation, there is still the problem of identifying the appropriate level of the tax. To accomplish this, the policymaker must have information on the control costs incurred by the affected firms. To the extent that the tax is set too high or too low, the target will not be met. To overcome this problem, policymakers could use an iterative process that entails adjusting tax rates until the target is met. This approach is politically unattractive, however, and may have adverse incentives effects on firms who must periodically modify their waste reduction strategies in response to changes in tax rates. In this regard, direct regulation possesses an advantage over taxes to the extent that direct regulation is more likely to attain the target in the short run.

A system of transferable discharge permits (TDPs) can be equally cost-effective as a tax set at the appropriate level. In the example considered here, the regulatory authority would issue a number of TDPs consistent with the ten unit decrease in waste generation. Regardless of the initial allocation of the TDPs, firms would find it in their interest to trade TDPs until the per-unit price of the permits was equal to the marginal

cost of control by both firms. The firms would in turn engage in the same amount of waste reduction that they would have under the tax scheme.⁴

To the extent that subsidies in the form of research grants foster technological innovations in waste reduction, subsidies may enhance efficiency. In addition, subsidies of this type do not have the same effect on costs as direct payments and may not have the same adverse incentives effects (which are described below in Section 5.3.3). In contrast, subsidies that encourage the adoption of specific techniques may be counterproductive in terms of efficiency. In particular, the technology being subsidized may not be the most efficient technique available to achieve waste reduction, in general or with respect to specific firms.

Voluntary compliance programs are probably the least likely to result in an efficient outcome. This is due, in large part, to their reliance on firms to adopt specific waste reduction measures. Recall from Chapter 4 that, as a general rule, firms do not consider external costs and benefits in their production decisions. If firms do not account for external costs and benefits, they will not produce the socially efficient level of output—in this case, waste reduction. Education and technology transfer may facilitate waste reduction efforts by individual firms but, once again, they suffer from the fact that the firm's decision of whether to adopt specific strategies is based on internal costs. Voluntary compliance programs are ill-equipped to encourage firms to consider the external costs of production in their decisionmaking process.

5.3.1.2 Equity

The equity or fairness of a particular policy can be evaluated in terms of its effects on firms and consumers. Depending on the policy in question, particular firms may end up bearing a disproportionate share of the burden associated with achieving a particular objective. In a similar manner, particular consumers may bear a disproportionate share of the benefits and costs of waste reduction.

Industry. From the perspective of equity, economic incentives and voluntary compliance programs are most favorable to industry. Both of these sets of policy options allow firms freedom in responding to standards and other initiatives for waste reduction in the manner they deem most appropriate. Taxes, for instance, recognize the potential for substantial differences in costs of control among firms. Thus, firms can respond to

⁴For a more detailed discussion see Tietenberg (1988), pp. 319-20.

specific requirements such as waste reduction targets in the manner that is most cost-effective for them. In addition, taxes more evenly allocates costs across affected firms.

Direct regulation, in its traditional form, can have very inequitable effects on firms. For example, some firms may produce outputs or utilize production processes or inputs that can be readily adapted to mandated waste reduction targets at minimal cost. In contrast, other firms may have very limited options as a result of stringent product performance criteria or a lack of available alternatives for producing particular outputs. In addition, smaller firms may have limited resources to engage in research and development activities that could ultimately lower the costs of compliance with specific regulations. Direct regulation fails to recognize these differences. It should be noted, however, that some commentators have argued that direct regulation is equitable to the extent that it treats all firms equally.

Consumers. Depending on the market in which certain goods are produced, consumers may bear more or less of the cost of waste reduction efforts engaged in by firms. As discussed in Tietenberg (1988) if a product is produced in a competitive industry, all the costs of pollution control (in this case waste reduction) are passed on to consumers. If the same product is produced in an imperfectly competitive market, however, part of the costs are borne by the firm. Consequently, the market structures in which affected firms operate will affect the distribution of waste reduction costs.

The extent to which increased production costs translate into higher product prices may also affect the distribution of costs across consumers of the same good. In particular, because expenditures on a specific item require a greater percentage of income from a low-income person than a high-income person, the same increase in price may be borne disproportionately by the poorer person.

Subsidies also may have disproportionate effects on consumers depending on how the subsidy is funded. For example, if the subsidy is funded by income taxes, the effect may be progressive—that is, high-income individuals pay a higher proportion of the cost of the subsidy program than low-income individuals due the progressivity of the income tax.

5.3.2 Feasibility and Acceptability

In addition to the questions of efficiency and equity, it is important to assess the feasibility and acceptability of specific policy options. As it is used here, feasibility

refers to the ease of implementation and administration (i.e., monitoring and enforcement costs) associated with a particular policy. Acceptability refers to the views and likely responses of the different players (i.e., industry, policymakers, and consumers) to specific policy options.

5.3.2.1 Feasibility—Ease of Implementation

Certain policy options are easier to implement than others. For example, agencies such as IEPA have developed considerable experience implementing standards programs; this fact alone may make implementing a similar program in the area of waste reduction easier. In contrast, a standards approach combined with direct regulation can be very difficult to implement depending on the specific industries for which standards are to be set and, in particular, the types and quantities of wastes generated by the affected industries. Industry-specific studies will need to be conducted in order to establish standards that are both achievable and effective relative to the policy goals. Once the standard is set, the regulatory authority must then monitor the performance of individual firms.

A system of transferable discharge permits possesses many of the same attributes as direct regulation. In particular, a standard or target must be set before determining the appropriate number of permits to be issued and then distributing the permits. In addition, the regulatory authority must monitor individual firms to ensure that they do not violate the permits. Considerable costs may be incurred in determining which wastes should be part of the permit program, how many permits should be issued, and how the permits should be allocated initially.

Using taxes may impose considerably more difficulties. As was discussed above, to identify the correct tax rate (i.e., the tax rate that results in achievement of the standard) taxes may have to be adjusted up or down over time. Changing the tax structure would, in all likelihood, require action by the legislature, which may seriously undermine implementation efforts.

Subsidies and voluntary compliance programs are considerably more attractive when viewed from the perspective of implementation. Agencies are already in place that administer such programs. As such, implementing a new or related program should impose minimal new costs. In these situations, the major stumbling block would be

locating a reliable source of funding to support such programs that does not place an additional direct burden on taxpayers.

5.3.2.2 Feasibility—Administration

In spite of the relative ease of implementation, relying on direct regulation and taxes to achieve standards entails substantial monitoring and enforcement costs. The regulatory authority in charge of monitoring compliance needs to collect firm-specific data on the types and quantities of wastes generated and be able to verify the accuracy of the data collected. The regulatory authority could ameliorate these costs to some extent by requiring that firms conduct waste audits and submit the audit results on an annual basis.

The costs associated with the data requirements of a transferable discharge permits system that focuses on limiting the use of waste management strategies other than waste reduction (i.e., recycling, treatment, and disposal) would depend on whether activities occur on site or off site. In the case of off-site activities, firms wishing to recycle, treat, or dispose of wastes—presumably at a commercial facility—would have to present a permit to the facility operator. On-site activities would also require the proper permit. Given that there are considerably fewer off-site facilities, however, wastes that undergo recycling, treatment, or disposal on site would present greater monitoring difficulties for the regulatory authority. Nonetheless, the overall burden should be lower than in the case of direct regulation or taxes.

Enforcement costs are absent in the case of voluntary compliance programs. In the case of subsidy programs, it is necessary to ensure that firms use the subsidy for the intended purpose. For example, it would be important to ensure that grants for research are used for that purpose and to monitor progress in the research program on a regular basis.

5.3.2.3 Acceptability

Acceptability is a critical factor in selecting a particular policy strategy. When assessing the overall effectiveness of a particular approach to achieve waste reduction, policymakers must consider the manner in which affected individuals can be expected to react to specific policies. Policymakers should not assume that policies that are not considered “acceptable” will be ineffective. Rather they should recognize the possible effects that the negative reactions of affected parties may have on the ability to implement

specific policies as well as the potential litigation costs that may be incurred by affected parties. Policymakers also should recognize the effects that a particular policy may have on firms' incentives to go beyond the policy's stated objectives.

Acceptability can be assessed from the perspective of the individuals affected by a particular policy option. These individuals can be grouped into the following categories: industry, policymakers, and environmental groups. Note that both policymakers and environmental groups represent the interests of society (and, presumably, consumers). Because their perspectives are different, however, it is worthwhile to consider them separately.

Industry. From industry's perspective, voluntary programs and subsidies are obviously the most acceptable options. To the extent that some form of targets or standards are imposed, however, firms prefer policies that allow them the greatest amount of flexibility in responding to those standards. As such, the use of taxes or TDPs would be more acceptable than direct regulation.

Policymakers. Policymakers must weigh the expected effectiveness of a particular policy option against its implementation and administration costs. From the policymaker's perspective, the objective should be to generate the greatest increase in environmental quality at the lowest cost possible. Consequently, policy options that are relatively expensive to implement or administer may be considered less attractive by policymakers. Viewed in this light, voluntary compliance programs—especially education and technology transfer and assistance—and possibly TDPs might constitute preferred alternatives. But because the desire to achieve identifiable results diminishes the attractiveness of such options, policymakers may prefer direct regulation and economic incentives. For example, to the extent that reliable databases are developed, options such as mandatory percentage reductions might be attractive.

Environmental Groups. Environmental groups tend to focus on the benefits of pollution control programs and the need for immediate action to address significant environmental problems. In addition, economic approaches are often viewed negatively by environmental groups. To be specific, "free-market," profit-oriented economic policies are blamed for high levels of industrial pollution. Policies that attempt to use those same free-market, profit-oriented approaches to control pollution are therefore viewed with suspicion.

Consequently, environmental groups are likely to be less inclined to rely primarily on voluntary compliance programs. Instead, they tend to emphasize options that generate immediate results such as direct regulation. This is not meant to suggest that environmental groups consider the costs of pollution control to be unimportant. Rather, it reflects their emphasis on the need for environmental improvement before harm becomes irreversible.

5.3.3 Effectiveness

Ultimately, a policy must be judged on the basis of its effectiveness (i.e., whether it can be expected to achieve the goals of policymakers). As we noted in the introduction to this chapter, in the area of environmental policy the goal of policymakers is to protect and improve environmental quality and human health and welfare. Waste reduction has in turn been identified as one of the objectives that will facilitate achievement of that goal. The task policymakers face is selecting specific policy instruments that will achieve that objective.

To at least some extent, the effectiveness of a particular policy option is determined by its feasibility and acceptability. For example, a policy option that is, by and large, unacceptable to many of the affected parties may have little chance of becoming part of an overall policy strategy. In addition, effectiveness is determined, in part, by the firms' options for responding to the particular policy. For example, to the extent that firms can simply transfer wastes from one environmental medium to another in response to a particular policy, the policy would be considered ineffective.

5.3.3.1 Direct Regulation

Direct regulation is probably the most effective means of achieving reductions in the quantity of waste generated in the industrial sector. Unfortunately, the amount of time needed to formulate industry-specific standards may delay significantly the achievement of any positive effects on waste reduction. In addition, effectiveness is eroded to the extent that provisions are made for granting variances and exclusions under certain circumstances. Effectiveness is also determined, in part, by the expected penalties that result from failure to comply with the regulations in question. As was noted in Section 5.2.2.4, expected penalties must be sufficiently large to eliminate any expected benefits from failing to comply with the regulations.

5.3.3.2 *Economic Incentives*

The effectiveness of economic incentives will be determined to a large extent by the percentage of total costs accounted for by a firm's waste management strategy and the degree of competition in the industry in which the firm operates. When the costs of waste management make up only a very small percentage of a firm's total production costs, policies such as per-unit taxes on individual wastes are unlikely to significantly affect the firm's waste management decisions. In such cases, the demand for inputs into the production of waste management is very inelastic (i.e., the quantity demanded of a particular input is unresponsive to price changes). Similarly, if a firm controls a large share of the output produced by a particular industry, and product demand is relatively inelastic, the firm may be able to pass any cost increases on to its customers. When waste management costs make up a large percentage of total production costs or the industry is very competitive, economic incentives such as taxes can be expected to be much more effective.

The effectiveness of subsidies is more difficult to predict. The firm's decision of whether to take advantage of a tax investment credit will depend on the expected effect on the firm's objective function (e.g., maximization of profit) when the tax credit is netted out of the costs of the option in question. The same is true of low-interest loans designed to finance waste reduction efforts.

In some cases, the use of subsidies may cause adverse effects with respect to effectiveness. In particular, subsidies such as direct payments to firms to adopt specific technologies may lower the overall costs of production. As costs decline, this may increase the incentive for new firms to enter the market. As the number of firms increases, production increases and the total amount of waste generated may in fact increase, contrary to the original objective of the subsidy program.

5.3.3.3 *Voluntary Compliance Programs*

The overall effectiveness of voluntary compliance programs is subject to the greatest amount of uncertainty because of the asymmetrical nature of this approach. The success of this approach is dependent on the willingness of firms to adopt specific waste reduction strategies. In short, you can lead a horse to water but you can't make him drink. When firms are certain that adopting a particular waste reduction approach will benefit them, voluntary compliance programs will prove fruitful. In contrast, when firms

are uncertain whether they will derive benefits from adopting a particular waste reduction effort, voluntary efforts can be expected to be considerably less successful.

Also, as discussed in Chapter 4, although voluntary compliance programs will lead to some waste reduction, firms will not achieve the socially efficient level of waste reduction through this approach. Firms will only implement waste reduction up to the point at which marginal *private* benefits equal marginal private costs. Efficiency requires that the firm consider *social* benefits and costs.

In Chapter 3 we noted that, based on a survey of firms in Illinois, most firms have engaged, at least to some extent, in voluntary waste reduction efforts. However, information on specific waste reduction efforts, the effect of those efforts in terms of actual quantities of waste reduction for specific wastes, and the firms' longer-term waste reduction efforts is not available for all wastes in Illinois. In addition, the data that are available are based on a one-time survey. Hence, it is not possible to assess the overall effectiveness of these voluntary efforts.

5.4 SUMMARY OF RELATIVE STRENGTHS AND WEAKNESSES

Table 5-1 presents a summary of the relative strengths and weaknesses of the policy options considered in this chapter. As Table 5-1 illustrates, one of the major implications of the preceding analysis is that trade-offs exist among the various options available to policymakers. For example, although taxes are clearly more efficient than direct regulation, direct regulation will, in all likelihood, be more effective than taxes, at least in the short run.⁵ In a similar manner, voluntary compliance programs rank highest on the basis of feasibility but are probably the least effective policy options available.

We also can distinguish between the categories of policy options according to how each is viewed generally. In particular, the use of direct regulation is usually viewed as an adversarial approach. The regulatory authority and industry are pitted against each other and against environmental groups. Direct regulation entails charges and countercharges of unreasonableness on all sides and many times results in intervention by the judiciary to resolve specific disagreements.

⁵If the tax were set at the correct level initially, taxes would be as effective as direct regulation. As noted in Section 5.3.1.1, however, it is highly unlikely that the tax will be set at the correct level on the first iteration.

Table 5-1. Summary of Alternative Policy Options: Strengths and Weaknesses

Policy Option	Evaluative Criteria ^a					
	Desirability		Feasibility			
	Efficiency	Equity	Implications	Administration	Acceptability ^b	Effectiveness
<i>Direct Regulation</i>	low	low	moderate	low	low	high
<i>Economic Incentives</i>						
Taxes	moderate	high	low	low	moderate	moderate
TDPs	high	high	moderate	moderate	moderate	moderate
Subsidies	low	high	high	high	high	moderate
<i>Voluntary Compliance Programs</i>	low	high	high	high	high	low

^a“Low,” “moderate” and “high” are qualitative measures of the attractiveness of each policy option with respect to the criterion in question.

^bAcceptability is based on a qualitative average of the assessment of each of the three groups described in Section 5.3.2.3.

Voluntary compliance programs, on the other hand, suggest a spirit of cooperation. Policymakers and industry are viewed as working together to improve environmental quality. The actual effectiveness of this approach is subject to considerable debate, however, and serious questions have been raised regarding the actual commitment of industry to remedy the problems in question.

Economic incentives constitute a middle ground between the two previous extremes. From a theoretical perspective, the purpose of economic incentives is simply to ensure that all activities are priced on the basis of their true social cost or are otherwise produced at the socially efficient level. Nevertheless, economic incentives such as taxes are often viewed as simply another burden on the firm. Consequently, economic incentives may encounter the same level of resistance as direct regulation.

The preceding discussion clearly points to the need for the formulation of a composite approach—one that draws on several or all of the policy options available to encourage waste reduction in the industrial sector. The next chapter examines, in detail, the relationship between various policy options and specific waste reduction strategies in Illinois as part of the process of developing this composite approach for Illinois.

REFERENCES

- Allen, D. W. No Date. "Toxics Prevention Act: Briefing Paper." National Campaign Against Toxic Hazards. Boston, MA.
- Baumol, W. J. and W. E. Oates. 1988. *The Theory of Environmental Policy*, 2nd ed. Cambridge: Cambridge University Press.
- Tietenberg, T. 1988. *Environmental and Natural Resource Economics*, 2nd ed. Glenview, IL: Scott, Foresman and Co.
- U.S. Environmental Protection Agency. 1988. *The EPA Manual for Waste Minimization - Opportunity Assessments*. EPA 600/2-88/025.

CHAPTER 6

POTENTIAL EFFECTIVENESS OF POLICY OPTIONS FOR ILLINOIS

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CHAPTER 6

POTENTIAL EFFECTIVENESS OF POLICY OPTIONS FOR ILLINOIS

6.1 OVERVIEW

This chapter brings together the results of our analysis from the previous chapters to outline a waste reduction policy strategy for Illinois. The issues addressed here will set the stage for debating Illinois' short-run waste reduction strategy. In addition, the analysis will point to areas requiring additional research.

Section 6.2 evaluates the potential effectiveness¹ of the policy options described in Chapter 5—direct regulation, economic incentives, and voluntary compliance programs—relative to the basic waste reduction techniques available to firms. That is, for each waste reduction technique, we evaluate whether each policy option will encourage the implementation of that technique. This analysis is based on the criteria used in Chapter 5 to assess the policy options. Section 6.3 explores the results of Section 6.2 in light of the specific characteristics of waste generation—waste types, quantities, and industry types—in Illinois.

This analysis has several limitations. First, as was pointed out in Chapter 3, adequate data are not available on waste generation and management practices or existing waste reduction efforts. These data are necessary to evaluate the effectiveness of policies directed at waste reduction in the industrial sector. Second, the task of describing the types of industries that generate and manage wastes in Illinois to the extent needed to fully evaluate alternative policies is beyond the scope of this report. Consequently, the analysis that follows is meant to serve as a benchmark only. Although there will undoubtedly be exceptions to our conclusions, we feel that this approach will be useful in setting the stage for the development of a comprehensive waste reduction policy strategy in Illinois.

¹The term “effectiveness” should not be confused with the “effectiveness” criterion described in Chapter 5. In this chapter, the effectiveness of a policy option is characterized by its ability to promote firms' use of the basic waste reduction techniques.

6.2 EFFECTIVENESS OF POLICY OPTIONS IN FOSTERING IMPLEMENTATION OF BASIC WASTE REDUCTION TECHNIQUES

In Chapter 4 we identified a number of basic waste reduction techniques available to firms. For convenience, the techniques are listed below. They include

- better housekeeping/management,
- waste stream segregation,
- modification/substitution of inputs or raw materials,
- reformulation/redesign of product,
- equipment/technology modification, and
- process/procedure modification or substitution.

In addition to the techniques listed above, Chapter 4 discussed the importance of waste reduction audits and facility plans. Although audits and plans do not by themselves result directly in waste reduction, they are an indispensable element of a comprehensive, viable waste reduction strategy. Waste reduction audits identify all the wastes generated by a firm, where they are generated, how they are managed, the costs associated with their generation and management, and so forth. This information enables the firm to assess the potential—both technical and economic—for waste reduction within specific production processes. Audits also serve as a yardstick to measure the overall success of waste reduction efforts. Facility-specific plans enable the firm to approach waste reduction in a systematic and, presumably, efficient manner. Therefore, in addition to considering each of the waste reduction techniques, it is necessary to examine the approaches that could be used to encourage firms to conduct waste audits and develop facility plans on a regular and ongoing basis.

To simplify our analysis, we have grouped the techniques listed above into five broadly defined categories (see Figure 6-1):

1. waste reduction audits and facility plans
2. operations changes
3. input substitution
4. process changes
5. end-product changes

These five categories serve as the organizational structure for the rest of this section. For each category we discuss separately the potential effectiveness of each policy option and then summarize the relative effectiveness of the policy options.

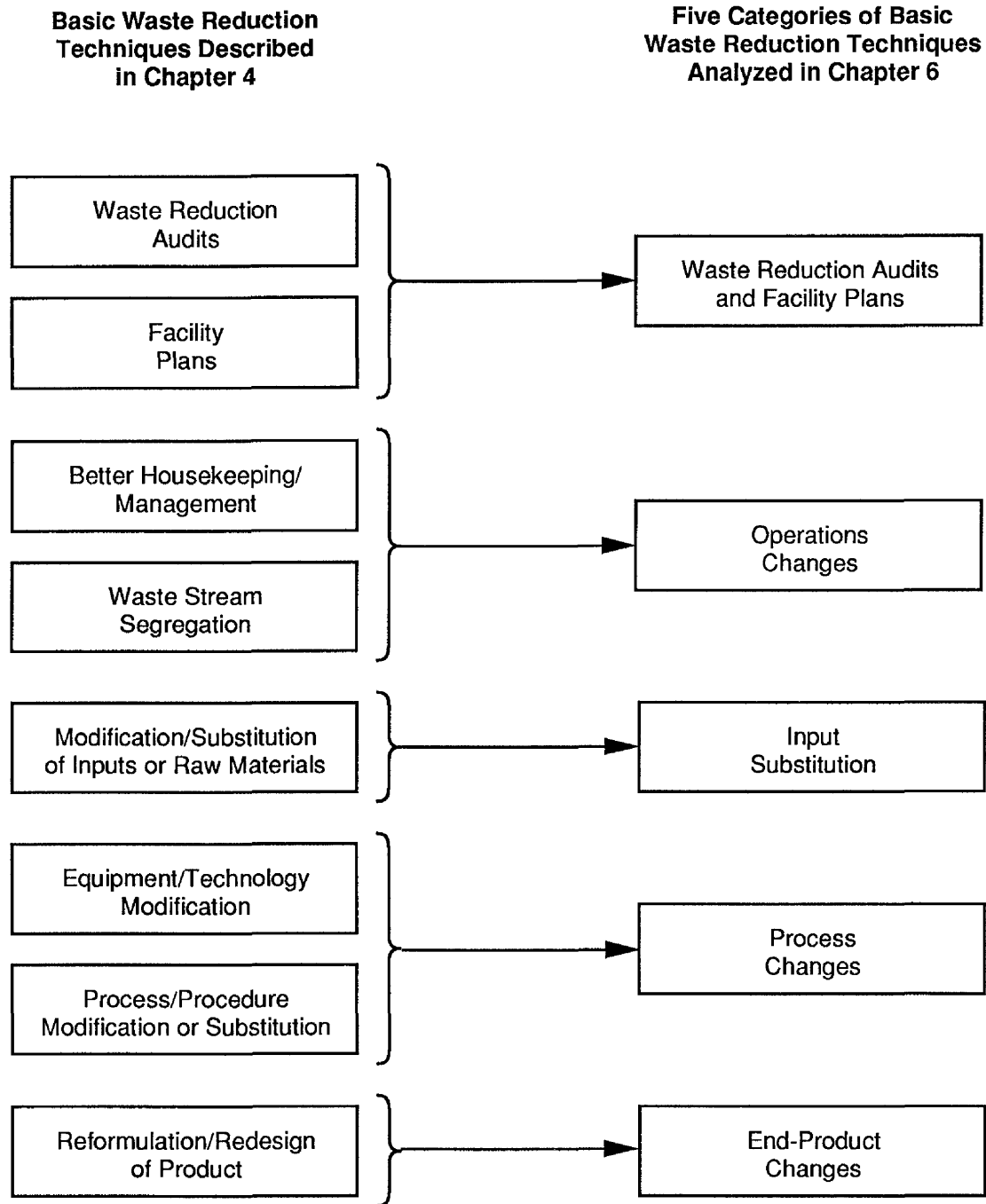


Figure 6-1. Five categories of basic waste reduction techniques.

6.2.1 Waste Reduction Audits and Facility Plans

Although the data presented in Chapter 3 indicate that many firms have begun to address the issue of waste reduction, the detail of individual firms' approaches is unclear. In particular, little information is available regarding the specificity of the waste audits that have been performed and the facility plans that have been developed. As such, policymakers will want to consider how the issue of waste reduction audits should be addressed.

6.2.1.1 Direct Regulation

Chapter 5 (Section 5.2.1.1) identified mandating waste reduction audits and plans as one direct regulatory policy option. To the extent that mandatory waste reduction audits are considered a viable option, several factors need to be addressed. These factors include who should be required to conduct an audit, how often audits should be conducted, the extent and type of audit results that must be reported to the regulatory authority, and how (by whom) the cost of the audit should be borne.

Who Is Covered? When conducting a waste reduction audit, a firm encounters difficulties that are closely linked to the number, complexity, and heterogeneity of the firm's production processes. Large firms that produce a variety of diverse outputs have much more difficulty conducting an audit than do small, single-product firms. Nevertheless, large firms probably generate the largest amount of waste and, therefore, could potentially achieve the greatest benefits, both internally and externally, from conducting a complete waste reduction audit. Therefore, it might be desirable to impose mandatory waste reduction audits only on firms that exceed some threshold criterion such as amount of waste generated per year, value of output per year, or some other indicator of firm size. This approach would ensure that waste audits are conducted by those firms that are most likely to benefit, while minimizing the monitoring and enforcement costs associated with this requirement.

As an alternative to using firm size as the basis for determining who will conduct an audit, mandatory audits could be imposed on those industries responsible for the majority of wastes generated. Table 6-1 summarizes data for nonhazardous and hazardous wastes presented in Tables 3-5 and 3-8 in Chapter 3. Referring to Table 6-1, approximately 69 percent of all nonhazardous special wastes are generated by the Fabricated Metal Products (SIC Code 34) and Chemicals and Allied Products (SIC Code 28) industries. In addition, 92 percent of these wastes are generated by industries in just

Table 6-1. Industries Generating the Largest Quantity of Waste in Illinois in 1986

SIC Code	Industry Description	Percentage of Total
<i>Nonhazardous Special Waste</i>		
34	Fabricated metal products	57
28	Chemicals and allied products	12
35	Machinery, except electrical	9
33	Primary metal industries	7
37	Transportation equipment	<u>7</u>
		92
	Other	8
	Total Nonhazardous Special Waste	100
<i>Hazardous Waste</i>		
33	Primary metal industries	43
34	Fabricated metal products	11
28	Chemicals and allied products	4
29	Petroleum and coal products	1
36	Electric and electronic equipment	<u>1</u>
		60
	Other ^a	40
	Total Hazardous Waste	100

^aFor hazardous waste, the industries classified as "other" each generated less than 1 percent of the total quantity of hazardous waste.

Source: Tables 3-5 and 3-8, Chapter 3 of this report.

five different two-digit SIC code industries. With respect to hazardous wastes, the Primary Metals (SIC Code 33) and Fabricated Metal Products industries generate approximately 54 percent of the hazardous wastes for which data are available. Approximately 60 percent of hazardous wastes are generated by industries in five different two-digit SIC codes.

As such, more than one-half of all the hazardous and nonhazardous special wastes for which data are currently available would be affected by focusing on seven different two-digit SIC codes. Consequently, policymakers may want to restrict mandatory waste audit and facility plan requirements to industries in those seven SIC codes. Once experience has accumulated, the mandatory audit requirement could be extended to other industries.

Frequency of Audits. Audits require a considerable amount of effort. More importantly, firms may need considerable time to implement changes such as production process modifications designed to reduce waste generation. In addition, firms may implement different waste reduction techniques identified by an audit over different time frames. Nevertheless, firms should conduct waste reduction audits at regular intervals—for example, on an annual basis. Audits are an excellent method of monitoring waste reduction efforts and also serve to maintain pressure on industry to achieve waste reduction. Conducting audits on a regular basis detects progress on short-term techniques, such as housekeeping measures, and tracks progress on long-term techniques. In addition, in many industries products and production processes are constantly changing. Annual audits would encourage facilities to reevaluate their waste reduction programs regularly and facilitate timely responses to these changes.

Information Requirements. The regulatory agency needs to maintain a system to monitor the performance and results of audits as well as the follow-up strategies selected by each firm. In developing a procedure that all firms would use for reporting results, the regulatory authority should balance the need for complete information against the need to protect the proprietary nature of much of the information developed by each firm. Therefore, it might be advisable to develop a certification process that would be conducted by a neutral third party. Certification would ensure that the appropriate procedures were employed in the audit while protecting the competitive interests of the firm.

Cost Considerations. Conducting a thorough waste reduction audit requires considerable time and effort, which translate into increased costs for the firm. These costs may be offset by savings that result from adopting specific techniques identified by the audit. In many instances, however, the payback period for the audit may span several years. Subsidies or low-interest loans could be used to help offset some of the cost of the audit.² Alternatively, imposing special fees on the treatment or disposal of wastes would provide funds for waste reduction audits.

6.2.1.2 *Economic Incentives*

As an alternative to imposing mandatory waste reduction audits on industry, policymakers could use economic incentives such as subsidies and low-interest loans to encourage firms to conduct audits. In addition, firms that conduct an audit could be

²This is an example of a composite policy that combines direct regulation with economic incentives.

granted a tax deduction, above and beyond the cost of the audit, for their effort. Alternatively, firms that do not conduct a waste audit could be required to pay a tax surcharge. Note that even in the case where mandatory audit requirements are imposed on specific firms, economic incentives could be used to encourage the performance of audits by unregulated firms.

6.2.1.3 Voluntary Compliance Programs

As an alternative, or a complement, to direct regulation or the use of economic incentives, firms could be relied on to voluntarily conduct waste reduction audits. In this case, policy options would consist of supporting education, technology transfer, and technology assistance programs designed to instruct firms on performing waste reduction audits and developing follow-up strategies. Providing awards and similar incentives would encourage voluntary efforts in this regard. For example, publicity could be given to “good neighbor” industries that make progress in waste reduction by voluntarily conducting audits.

6.2.1.4 Summary

The use of direct regulation can be expected to yield the most significant results in the near term. Moreover, although direct regulation has the potential to force inefficient behavior (i.e., the performance of audits in cases where they are not needed or are not expected to yield useful information) it is reasonable to assume that the benefits resulting from conducting audits would exceed the costs incurred. This assertion is supported by case studies of the benefits realized by firms that have conducted audits in the past. Nevertheless, depending on who is required to conduct an audit and who bears the cost of the audit, this approach may be viewed as inequitable.

Providing economic incentives or relying on voluntary compliance would mitigate the efficiency and equity problems just noted. But it is likely that these latter approaches would be considerably less effective than direct regulation in terms of the number of audits actually performed and the longer range benefits of waste reduction audits, measured as the amount of waste reduction that takes place over time. Without a specific requirement to conduct an audit, firms will only undertake an audit when the expected benefits exceed the expected costs. Firms’ benefit-cost analyses are likely to be based on inadequate information and may therefore lead to the wrong conclusion.

The preceding analysis suggests that a composite policy that employs all three options will yield the greatest amount of benefits per dollar spent on waste reduction audits. For example, a composite policy might consist of mandatory audits for selected industries coupled with a combination of subsidies, low-interest loans, and tax advantages for affected firms. Economic incentives and reliance on voluntary efforts could in turn be used to encourage waste audits by firms not affected by the mandatory requirements.

6.2.2 Operations Changes

Operations changes in a firm include managers' efforts to emphasize effective waste management and to improve housekeeping and waste management practices such as waste stream segregation. Managers have an incentive to encourage effective waste management at all production levels to the extent that production costs can be lowered as a result of such efforts. Unfortunately, managers may be unaware of problems within specific production processes. They also may be unaware of certain techniques that could be used to reduce waste generation. In a similar manner, the adoption of better housekeeping and waste management practices such as waste stream segregation may be impeded when managers lack information or are uncertain about effectiveness.

Firms can implement most types of behavior modifications at minimal cost and derive significant benefits. As such, getting firms to engage in effective waste management is a matter of making managers aware of the opportunities available. Waste reduction audits give firms information concerning management strategies. Developing policies directed specifically at operations changes may also be worthwhile.

6.2.2.1 Direct Regulation

Regulations requiring that firms conduct waste reduction audits and develop waste management plans would force firms to consider the full range of possible operations changes. In addition, regulations mandating maximum waste generation rates for specific production processes—for example, using the best available production process (BAPP) concept introduced in Chapter 5 (Section 5.2.1.2)—might indirectly encourage improved management and housekeeping practices.

Direct regulation could also be used to prevent the mixing of wastes when such a procedure results in increased quantities of hazardous wastes or precludes the possibility of on-site recycling or reuse. In fact, regulations currently exist that prohibit the mixing

of certain wastes and dilution of wastes to reduce hazard. This approach could be expanded to cover a larger number of wastes that are generated by specific industrial processes.

Regulations requiring firms to implement specific operations changes are not feasible. Management skills and steps such as improved housekeeping are not amenable to direct regulation because the regulatory authority cannot easily design a target level of performance that can be mandated for these types of behavior. To impose direct regulation on housekeeping and simple waste management practices, the regulatory authority would need to have intimate knowledge of each production process, setting standards on a process-by-process basis. To illustrate the problem, it is possible to prohibit treatment or disposal of wastes containing specific combinations of constituents and, in that way, force waste stream segregation. Wastes being disposed of must simply be monitored for those specific constituents. It is a quite different matter to establish that the quantity of a waste being manifested for disposal is, in part, the result of failure to segregate hazardous from nonhazardous components. This would require detailed process information on how the waste was generated.

6.2.2.2 *Economic Incentives*

Economic incentives could be used to encourage operations changes by raising the costs associated with waste generation and management. For example, taxes could be imposed on specific wastes or waste management options. The latter approach would increase the prices of waste treatment and disposal. As the costs of waste generation, treatment, and disposal increase, waste reduction becomes relatively less expensive. Firms therefore have an increased incentive to find ways to reduce treatment and disposal costs. These effects are indirect, however. Moreover, the overall effectiveness of such an approach will be determined, in large part, by the sensitivity of the firm to changes in treatment and disposal costs.³

6.2.2.3 *Voluntary Compliance Programs*

Voluntary compliance programs that rely on education and technology transfer are likely to be an effective means of inducing firms to implement simple operations changes. Using education programs to demonstrate to managers the cost-effectiveness of specific actions, as well as the effects of specific housekeeping practices, would have the most

³This topic is discussed in detail in Chapter 5, Section 5.3.3.

direct effect on the behavior of firms. In particular, case studies targeted at specific industries that illustrate the approach and benefits of operations change would be most beneficial.

6.2.2.4 Summary

Developing a composite program that includes direct regulations requiring firms to develop management plans combined with economic incentives and voluntary compliance programs would be an effective approach to encourage firms to implement operations changes. Direct regulation, however, should be limited to requiring the firm to develop a plan that considers the effects of the range of management strategies and, possibly, rules governing the handling and disposition of specific waste streams. Economic incentives may have some effect, but the effects will be indirect, at best. Technology transfer and technical assistance should be productive in this regard.

6.2.3 Input Modification/Substitution

The ability and willingness of a firm to engage in input modification or substitution depends on the nature of the firm's output, the availability of substitute inputs, and the costs of alternatives to the current input choice. Input modification or substitution is also a function of the waste in question. When an input is responsible for a small amount of waste relative to the total amount of wastes generated by the firm or the waste generated poses no problems with respect to management and disposal, the incentives for input modification or substitution are minimal. In other cases, product performance requirements and contractual specifications may limit the firm's ability to engage in input modification or substitution, regardless of the potential benefits to the firm. As such, the effects of this approach to waste reduction tend to be firm specific and process specific.

6.2.3.1 Direct Regulation

In some cases, direct regulation could be used as a means of forcing input modifications or substitutions. For example, the regulatory authority could implement regulations mandating that inputs meet purity or quality standards before being used in a particular production process. In addition, regulations could ban inputs from use in the production of certain products (e.g., inputs resulting in the generation of hazardous waste). As a specific example, the regulatory authority could explore the feasibility of requiring that water-based inks be substituted for solvent-based inks in printing processes

wherever technically and economically reasonable. Promulgation of such regulations would require extensive research to establish standards that are both effective and achievable. In addition, monitoring and enforcement would require data, such as random samples of inputs used by specific firms, to ensure that standards are being met.⁴

6.2.3.2 *Economic Incentives*

From an economic perspective, the amount of a particular input that is employed by a firm is a function of the price of the output that the input is used to produce, the productivity of the input, the price of the input, and the prices of related inputs. Consequently, a change in any of these factors may cause firms to change the amount of the input they use. For example, an increase in the price of the input will lead firms to decrease the amount of the input they use, all else constant.

Related inputs fall into one of two categories: substitutes or complements. “Substitutes” are inputs that could be used in place of each other. In some cases, firms have access to a large number of substitute inputs. In other cases, no feasible substitutes exist. For example, water-based inks can be substituted for solvent-based inks in a variety of production processes. In specific situations, however, using water-based inks may not be feasible. A decrease in the price of a substitute causes the demand for the input in question to decrease and vice versa. In the ink example, a decrease in the price of water-based inks would cause the demand for solvent-based inks to decrease. “Complements” are inputs that are used together, such as bottles and water in the production of bottled water. An increase in the price of an input would cause the demand for its complement to decrease (because less of the initial input would be purchased).

Policies that alter the relative prices of inputs will encourage firms to engage in input substitution. Referring once again to the ink example, imposing a tax on solvent-based inks would cause their relative price to rise. Firms would then have an increased incentive to consider possible input substitutions (e.g., water-based inks.) A subsidy linked to the substitute input, in this case, the water-based inks, would have the same effect.

To the extent that the regulatory authority can isolate inputs that significantly contribute to waste generation, economic incentives could be used to encourage waste

⁴Mandatory waste reduction audits that require data on the inputs used and the amount and type of waste generated may encourage facilities to implement input substitution.

reduction. As the preceding statement suggests, however, using taxes and subsidies to encourage input substitution will entail major data requirements. In addition, the effectiveness of this approach depends on how sensitive an input is to changes in prices. As the elasticity of demand for the input decreases, so does the effectiveness of economic incentives. In any event, the effectiveness of this approach must be evaluated on a case-by-case (i.e., industry-by-industry and input-by-input) basis.

6.2.3.3 *Voluntary Compliance Programs*

Voluntary compliance programs can encourage input substitution by providing firms information regarding input substitution opportunities as well as the benefits and costs associated with this option. In this regard, technology transfer and technical assistance programs could play an important role.

According to a recent case study in Illinois, a printing firm decided to substitute water-based inks for solvent-based inks after considering the health benefits to employees, the reduced disposal costs, and the corresponding reduction in potential liabilities (Kraybill et al., 1989). As a result of the input substitution, the firm realized immediate cost savings in the form of reduced disposal costs. Education and technology transfer programs that disseminate information on success stories such as the preceding example should result in additional waste reduction.

It is important to note once again that firms respond to relative prices of different inputs in making decisions concerning the use of specific inputs. Firms can incorporate knowledge of external costs and benefits into their decisionmaking processes, provided they have the necessary information. To the extent that this information is not available, firms may make decisions that are inefficient from the perspective of both society and the firm. Voluntary compliance programs help address this important issue by providing additional information to firms. Even if provided with this information, however, firms may not fully consider the implications of external costs (i.e., the costs to society) in their decisionmaking processes. In this regard, voluntary compliance programs cannot be relied on, by themselves, to ensure that firms employ socially beneficial input substitutions.

6.2.3.4 *Summary*

Direct regulation and economic incentives—in particular, restrictions on the use of specific inputs and taxes—are most likely to influence firms' behavior with respect to

input modification or substitution. Unfortunately, these approaches are data intensive and are therefore difficult to implement. In specific situations (i.e., where case studies are available that indicate net benefits from input substitution), voluntary compliance programs may also be effective. Consequently, a mix of all three policy options that focuses on direct regulation and economic incentives is likely to generate the greatest net benefits with respect to waste reduction.

6.2.4 Process Changes

Process changes include a number of specific options ranging from equipment or technology modification, to process/procedure modification or substitution, to in-process recycling. A firm's ability to engage in one or more of these activities will be influenced by a number of factors including the nature of the firm's production processes and the output(s) it produces, the types of wastes that it generates, and the number and type of technologically feasible alternatives currently available.

6.2.4.1 Direct Regulation

Depending on how it is structured, direct regulation may be more or less effective as an approach to encourage or force process changes. In particular, promulgation of regulations mandating specific design standards would require a significant amount of background research by the regulatory authority and would have to be very product specific. In addition, much of the information required to assess the feasibility of process changes is of a proprietary nature. As such, in many situations, meaningfully assessing the potential for process change would be extremely difficult, if not impossible.

Some of the problems just noted would be minimized by relying on performance standards rather than design standards. As was noted in Chapter 5 (Section 5.2.1.2) USEPA has developed performance standards as part of the implementation of HSWA's restrictions on the land disposal of hazardous wastes. Developing standards based on, for example, a best available production process for specific industries and wastes would allow a firm to comply with the standard in whatever manner the firm determines to be appropriate.

Using direct regulation to force process changes also has important efficiency implications. Specifically, direct intervention into firms' production decisions limits firms' ability to respond to relative prices in the course of making production decisions. Consequently, depending on how regulations are structured, firms may be forced to make

decisions that are economically inefficient. For example, requiring that certain inputs, such as used solvents, be recycled within the production process may be economically inefficient for small firms, especially if the recycling process is characterized by significant economies of scale.

From the perspective of efficiency, economic incentives are preferable to direct regulation.⁵ Performance standards are more efficient than design standards, because performance standards provide the firm with more flexibility in achieving the standard. Therefore, the costs associated with a performance standard generally will be lower than the costs associated with a design standard that achieves the same level of waste reduction.⁶

6.2.4.2 *Economic Incentives*

Economic incentives including taxes, investment tax credits, and subsidies (including low-interest loans) could be used to encourage process changes. For example, a tax could be imposed on certain virgin materials such as solvents to create an incentive for firms to consider closed-loop recycling of used solvents. Investment tax credits and subsidies could be used to induce firms to engage in capital-intensive production process modifications. Subsidies could also be used to support industry-specific or firm-specific research and development as it pertains to process changes.

Tax incentives, such as temporary reductions in tax rates, could also be used to reward firms that engage in substantive waste reduction efforts including in-process or closed-loop recycling. Unfortunately, this approach would impose a considerable burden on the regulatory authority. In particular, implementing this approach requires collecting and verifying extensive data.

6.2.4.3 *Voluntary Compliance Programs*

Many of the process changes discussed in Chapter 4 (Section 4.2.9) involve very simple measures that are relatively inexpensive to implement. It is reasonable to expect that the major impediment to adoption of these techniques is simply a lack of information. Education and technology transfer could be used to address this issue in a cost-effective manner. In a similar fashion, technology transfer programs could be used to provide

⁵This same general argument applies to the relative effects of direct regulation and economic incentives on input modification/substitution.

⁶At most, the costs associated with each approach would be equal.

firms with information about other firms' success with more sophisticated options such as closed-loop recycling to reduce waste generation rates and production costs as well as production process changes and equipment modifications.

6.2.4.4 Summary

A composite approach that combines direct regulation, economic incentives, and voluntary compliance programs—in particular, technology transfer and technical assistance—would be the most effective way to encourage process changes in the industrial sector. This conclusion stems from the relative strengths and weaknesses of each policy option with respect to this technique and the fact that a single option does not dominate.

Direct regulation will require considerable effort on the part of the regulatory authority as a result of the firm-specific and production-process-specific nature of many of the process modification strategies available to firms. Nevertheless, mandatory performance standards will encourage all firms to explore the full range of approaches to waste reduction. These efforts may lead firms to realize additional benefits through the process of technology transfer. Approaches that are more generic in nature (i.e., increased drain time for parts subjected to an immersion process) lend themselves to education and technology transfer. Economic incentives would be effective, especially when altering the relative prices of affected inputs makes efforts such as closed-loop recycling economically feasible.

6.2.5 End-Product Changes

As described in Chapter 4 (Section 4.2.7), product reformulation and redesign—or end-product changes—constitute one of the more radical approaches to waste reduction. Note, however, that this approach opens the door to considering all the other waste reduction techniques that have been discussed thus far. Investigating the potential for end-product changes will entail considering alternatives for input modification/substitution and process modification. Consequently, the discussions of the effectiveness of policy options pertaining to each of those techniques apply here as well. When viewed as a distinct approach to waste reduction, however, end-product changes involve additional considerations.

6.2.5.1 Direct Regulation

When a clear case could be made that the social costs associated with a particular product outweigh its benefits, direct regulation could be used to force end-product

changes. For example, regulations could be implemented that ban the product outright or ban the production process or certain inputs used to produce the product. Regulations governing volatile organic compounds emissions spurred the development of alternative, water-based coatings (i.e., paints). Although examples like this do exist, implementing this approach would most likely be extremely difficult and costly.

6.2.5.2 *Economic Incentives*

As an alternative to direct regulation, the regulatory authority could impose per-unit taxes on products whose production leads to the generation of a specific waste. Because of the resulting increase in the price, consumers would purchase less of the product. This would create an incentive for firms to explore the possibility of a product reformulation or redesign that does not generate the waste in question. One important factor to consider, however, is that this approach may simply lead to the increased generation of other wastes that are not covered by the tax.

6.2.5.3 *Voluntary Compliance Programs*

When a product is produced by a large number of firms, support for research and development could facilitate efforts to reformulate or redesign specific products. In addition, demonstration projects could be used to encourage the firms in an industry to adopt specific changes that have proven beneficial for a particular firm. Because such efforts are very product specific, however, benefits would often be limited to individual firms and, in some cases, industries.

6.2.5.4 *Summary*

Each of the policy options considered here has the potential to encourage end-product changes in specific instances. The success of this approach to waste reduction will depend, in large part, on the amount of effort devoted to analysis of specific situations. Compared to the other waste reduction techniques we have considered, end-product changes would appear to be the most difficult to effect through public policy initiatives.

6.3 EFFECTIVENESS OF POLICY OPTIONS FOR ILLINOIS INDUSTRIES

As part of an analysis of opportunities for waste reduction in the industrial sector, the Office of Technology Assessment (OTA) examined the relationship between waste

reduction techniques and industry/product types (OTA, 1986). OTA's results, which have been recreated here as Table 6-2, indicate that the potential for waste reduction opportunities varies considerably depending on industry characteristics. According to OTA's analysis, industries involved in the large-scale manufacture of consumer goods appear to have the greatest potential for successful waste reduction efforts. At the other extreme, the potential for waste reduction in industries that produce goods with very stringent specifications or that are characterized by demands for high product quality appears to be very limited.

Combining the information in Table 6-2 with information on the types and quantities of wastes generated in Illinois and, in particular, the types of industries that generate those wastes should provide additional insights to the relative effectiveness of specific policy options. As the discussion in Section 6.2 indicated, certain policy options will be more or less effective with respect to specific waste reduction techniques. Depending on the types of industries that generate waste in Illinois, certain policies may be more appropriate than others.

Once again, it is important to note the limitations of the following analysis. Currently, data are only available for a portion of all industrial wastes generated in Illinois; primarily, toxic wastes, hazardous and nonhazardous special wastes, and certain water effluents. Limited data are available regarding air emissions and other solid wastes generated by industry. Consequently, the results that follow must be viewed with these constraints in mind.

6.3.1 Summary of Waste Generation in Illinois

As Table 6-1 illustrated, currently available data indicate that a small number of industries account for the majority of the hazardous and nonhazardous special wastes generated in Illinois. In fact, the Fabricated Metal Products industry (SIC Code 34) accounts for 57 percent of the nonhazardous special wastes generated in the state. In a similar fashion, the Primary Metal Industries (SIC Code 33) and the Fabricated Metal Products Industry (SIC Code 34) account for 43 percent and 11 percent, or a total of 54 percent, of all hazardous wastes.

One option for Illinois is to focus efforts on these industries and then expand to other industrial sectors as more is learned about the relative effectiveness of specific policy options. In Section 6.3.2 we describe policy options for these two industries, which we

Table 6-2. Potential Waste Reduction Techniques for Different Industry Types

Company/Industrial Characteristic	Typical Industries	Waste Reduction Techniques				
		1	2	3	4	5
Mature process technology, high-volume product	Rubber Petroleum Commodity chemicals Paper products Lumber	+	-	-	+	-
Very stringent product specifications or high product quality demands for high- cost/high-profit products	Pharmaceuticals Weapons Robotics Specialty chemicals	+	-	-	-	-
Frequently changing high-tech products; components for industrial use	Electronic Medical equipment	+	+	+	+	-
Job shop processing of many different industrial products	Electroplating }	+	+	+	+	-
	Printing } Foundries } Machine shops }	+		-	+	-
Changing production technology for industrial goods	Steelmaking Nonferrous metals Textiles	+	-	+	+	-
Large-scale manufacture of consumer goods	Automobiles Appliances Consumer electronics Paints	+	+	+	+	+

Key for waste reduction techniques:

- 1 = operations changes
- 2 = input substitution
- 3 = process changes
- 4 = in-process recycling
- 5 = end-product changes

Source: OTA (1986), p. 95.

developed by combining the information in Table 6-2 and the results of Section 6.2. An additional input to our analysis was a more detailed examination of the specific types of firms that operate in these two industries in Illinois. This information is provided below.

6.3.1.2 *The Fabricated Metal Products Industry in Illinois*

According to data collected by the U.S. Bureau of the Census (1986), approximately 2,405 firms were operating in the Fabricated Metal Products industry in Illinois in 1984. The principal outputs of firms in this industry are

- metal cans and shipping containers;
- cutlery, hand tools, and hardware;
- plumbing and heating, except electrical;
- fabricated structural metal parts;
- screw machine products, bolts, etc.;
- metal forgings and stampings;
- metal services;
- ordnance and accessories; and
- miscellaneous fabricated metal products.

Recall that Table 6-2 grouped industries into six company/industrial classifications and evaluated the potential for waste reduction techniques for industries under each of these six classifications. Similarly, the outputs in the Fabricated Metal Products industry can be grouped into four broad categories as shown in Table 6-3. In particular, SIC codes 341, 342, 343, and 349 can be grouped together under the heading of “large-scale manufacture of consumer goods.” Firms in SIC codes 345, 346, and 347 can be grouped together under the heading of “job shop processing.”

6.3.1.3 *The Primary Metal Industries in Illinois*

Approximately 489 firms operated in the Primary Metal industries in Illinois in 1984. The principal outputs of the firms in this industry include

- blast furnace and basic steel products,
- iron and steel foundries,
- primary nonferrous metals,
- secondary nonferrous metals,
- nonferrous rolling and drawing,
- nonferrous foundries, and
- miscellaneous primary metal products.

Table 6-3. Potential Waste Reduction Techniques for Firms in the Fabricated Metal Products Industries^a

Company/Industrial Characteristic	SIC Code	Output	Waste Reduction Techniques				
			1	2	3	4	5
Mature process technology, high-volume product	N/A ^b	—					
Very stringent product specifications or high product quality demands for high cost/high profit products	348	Ordnance & accessories	+	-	-	-	-
Frequently changing high-tech products; components for industrial use	N/A ^b	—					
Job shop processing of many different industrial product	345	Screw machine parts	+	+	-	+	-
	346	Metal forgings					
	347	Metal services					
Changing production technology for industrial goods	344	Fabricated structural parts	+	-	+	+	-
Large-scale manufacture of consumer goods	341	Metal cans, etc.	+	+	+	+	+
	342	Cutlery, hand tools					
	343	Plumbing & heating					
	349	Misc. fabricated products					

Key for waste reduction techniques:

- 1 = operations changes
- 2 = input substitution
- 3 = process changes
- 4 = in-process recycling
- 5 = end-product changes

^aFabricated Metal Products industries include all industries under SIC Code 34.

^bNo Fabricated Metal Products industries can be classified under this company/industrial characteristic.

The outputs in the Primary Metal industries can be grouped into two broad classifications from Table 6-2, as shown in Table 6-4. In particular, SIC code 332 falls under the heading of “job shop processing.” Firms in SIC codes 331, 333, 334, 335, 336, and 339 can be grouped together under the heading of “changing production technology for industrial goods.”

Table 6-4. Potential Waste Reduction Techniques for Firms in the Primary Metals Industries^a

Company/Industrial Characteristic	SIC Code	Output	Waste Reduction Techniques				
			1	2	3	4	5
Job shop processing of different industrial products	332	Iron and steel foundries	+	+	-	+	-
Changing production technology for industrial goods	331	Blast furnace, basic steel	+	-	+	+	-
	333	Primary nonferrous metals					
	334	Secondary nonferrous metals					
	335	Nonferrous rolling, drawing					
	336	Nonferrous industries					
	339	Misc. primary metal products					

Key for waste reduction techniques:

- 1 = operations changes
- 2 = input substitution
- 3 = process changes
- 4 = in-process recycling
- 5 = end-product changes

6.3.2 Policy Implications

Combining the information in Tables 6-2, 6-3, and 6-4 suggests that policies focusing on operations changes, in-process recycling and, to a lesser extent, process changes and input substitution would have the greatest probability of success with respect to waste reduction in the Fabricated Metal Products and Primary Metals industries. Referring to the analysis in Section 6.2, this suggests that policies relying primarily on mandatory waste reduction audits, specific regulatory initiatives, and selected economic policies (e.g., taxes on specific inputs and waste management practices) would be most effective.

As shown in the analysis in Section 6.2, complementing these policies with expanded funding for education, research and development, technology transfer, and technical assistance should yield substantial net benefits. The state has already begun to employ voluntary compliance programs, primarily through the creation of the Hazardous Waste Research and Information Center (HWRIC) and the services it offers. Clearly, however, HWRIC could play an even bigger role than is currently possible given staff and funding constraints.

6.4 SUMMARY

This chapter has examined the relative effectiveness of alternative policy options with respect to waste reduction techniques available to firms in Illinois. The most effective policy strategy will consist of a combination of the alternative options available to policymakers. Choosing the particular policy options to use in this combination approach will require information on the industries that are responsible for waste generation in Illinois.

The majority of wastes for which data are currently available are generated by very few industries. Consequently, policymakers should probably develop an initial policy strategy that focuses on these industries. As more is learned about the relative effectiveness of specific policy options, this information could be used to formulate policies directed at additional waste generating production processes. Chapter 7 provides specific policy recommendations based on the results of the analysis presented in this and the preceding chapters.

REFERENCES

- Kraybill, D. D., S. Mehta, and D. Thomas. 1989. "Waste Reduction Case Histories: What's Worked, What Hasn't, and Why." *Proceedings of the Second Annual Hazardous Materials Management Conference/Central*, March 14-16, 1989.
- Office of Technology Assessment. 1986. *Serious Reduction of Hazardous Waste: For Pollution Prevention and Industrial Efficiency*. OTA-ITE-317. Washington, DC.
- U.S. Bureau of the Census. 1986. *County Business Patterns, 1984: Illinois*. Washington, DC: U.S. Government Printing Office.

CHAPTER 7

RECOMMENDATIONS AND CONCLUSIONS

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CHAPTER 7

RECOMMENDATIONS AND CONCLUSIONS

7.1 OVERVIEW

This report has explored policies that could be used in Illinois to encourage industry to reduce waste generation. It is clear that there is much to learn about the generation of wastes in Illinois. Nonetheless, we can formulate policies that will encourage firms to implement waste reduction. As our knowledge of the types and quantities of wastes generated in Illinois increases and as additional waste reduction techniques are developed and implemented, these policies can be expanded.

In Chapter 1, we defined waste reduction to include all measures that can be taken within a facility to reduce the quantity and/or the toxicity of waste generated. This definition includes on-site recycling but does not include off-site recycling. Off-site recycling is usually the less preferred management option because of the risk incurred in transporting wastes. However, if waste reduction is not feasible, off-site recycling is usually the preferred waste management method.

Chapter 2 discussed a number of the federal and state policy efforts designed to encourage industrial waste reduction. Whereas many of these policy efforts have focused on hazardous waste reduction or toxics use reduction, we have taken a broader approach in this report to encourage reductions in all industrial wastes. Our experience with Illinois industry has shown that companies with successful waste reduction programs have focused on the flow of all materials through their plants and the generation of all wastes released to all media. Focusing on all wastes generated is the best way to achieve our overall objective of minimizing the total risk to human health and the environment posed by waste generation.

Despite our emphasis throughout this report on reducing all industrial waste at the source, or recycling where source reduction is not practical, we believe that the state has acted correctly by focusing initially on some of the more toxic wastes. In particular, the Toxic Pollution Prevention Act (TPPA) mandates the Illinois Environmental Protection Agency (IEPA) and the Hazardous Waste Reduction Information Center (HWRIC) to focus on the reduction of toxic chemicals, as identified in the Toxic Release Inventory.

(See Appendix C for the text of the Toxic Pollution Prevention Act and its enrolled amendments.) It is these chemicals for which the state has the most information, and this is the only group of chemicals for which we have data on releases to all media. Thus, we encourage the state to proceed with implementing and expanding TPPA, while at the same time considering the broader recommendations as outlined below.

Case studies show that waste reduction can be a true “win-win” situation: industry can realize greater profits and efficiency while both human health and the environment can be protected. Still, there is some reluctance to implementing waste reduction on the part of industry. Chapter 4 discussed some of the barriers to implementing waste reduction. The challenge for government is to find ways (through regulation, economic incentives/disincentives, or voluntary programs) to encourage industry to reduce waste at the source. One recommendation presented in Chapters 5 and 6 is to design a composite strategy that incorporates all the major policy approaches. This chapter presents specific recommendations that are intended to aid Illinois in its development of a comprehensive waste reduction framework.

7.2 RECOMMENDATIONS

The State of Illinois Office of the Auditor General conducted a management audit of the Illinois Environmental Protection Agency’s Hazardous Waste Management Program (Auditor General, 1989). One area addressed in the audit is hazardous waste reduction. The Auditor General recommends that states adopt a more aggressive approach to waste reduction. Recommendations made by the Auditor General are as follows:

- adopting legislation mandating hazardous waste reduction, such as a mandated hazardous waste recycling program or specific time frames for reducing certain types of hazardous wastes;
- expanding IEPA’s waste reduction activities, such as reviewing generator waste reduction programs as part of their routine inspections and granting IEPA administrative citation authority to enforce waste reduction requirements; and
- requiring companies that receive state financial assistance to comply with the waste reduction reporting requirement.

Recommendations from our study go well beyond the Auditor General’s recommendations on hazardous waste. We recommend that the state develop a comprehensive waste reduction framework that addresses all waste generated by industry and releases to all environmental media. Only by eventually addressing the whole waste

problem can Illinois reduce total risk to human health and the environment from waste. In addition, a waste reduction framework needs to address the life cycle of materials through the industrial process. Decisions about post-consumer waste (e.g., whether to make a product biodegradable or recyclable) will affect the waste that industry generates in making a product. For example, a group of industry, environmental, and government representatives have suggested that degradable plastics could deter recycling and source reduction efforts and could leave harmful by-products in the environment (*Environmental Reporter*, p. 1378, Bureau of National Affairs, Inc. December 8, 1989). Reducing the environmental impact of disposing a product while disregarding the impact of the waste that is generated in making a product may in the long run create as many problems as are solved. Therefore, the recommendations made in this study should be integrated with those made in the companion report, "Post-Consumer Waste Reduction: State Policy Options," to create a comprehensive framework to reduce all waste generation in the state.

We present eight recommendations for developing a comprehensive waste reduction framework. We have divided these recommendations into three categories: general policies, direct regulations, and economic incentives. Table 7-1 lists our specific recommendations.

Table 7-1. Waste Reduction Policy Recommendations

General Policies

1. Develop Statement of Government Commitment to Waste Reduction
2. Form a State Industrial Waste Reduction Advisory Task Force
3. Develop New Reporting Requirements
4. Develop Technical Assistance, Research, and Education Programs

Direct Regulations

5. Mandate Waste Reduction Audits
6. Mandate Waste Reduction Plans

Economic Incentives

7. Provide Grants and Loans
8. Levy Fees and Taxes

7.2.1 General Policies

The recommendations in this section rely on nonregulatory approaches by government to encourage industrial waste reduction. These general policies are an important aspect of the composite strategy we recommend. They provide the vehicles to enable policymakers to formulate a successful waste reduction program and establish an environment of cooperation between industry and Illinois government.

Recommendation 1: Develop Statement of the Government's Commitment to Waste Reduction

The State of Illinois is committed to implementing a waste reduction program. This is evident in waste reduction being the number one waste management priority in the Solid Waste Management Act, in the mandate to HWRIC in its enabling legislation to promote source reduction, in passage of the Toxic Pollution Prevention Act in September 1989, and in the mandate to prepare this report and the post-consumer waste report.

We recommend that the state enhance this position by developing a strong policy statement reflecting its commitment to multi-media waste reduction and to the primacy of waste reduction. For solid waste, the legislature should encourage waste reduction and off-site recycling as an important component of the state's waste management scheme. The waste reduction policy statement might read as follows:

In the interest of protecting human health and safety and the environment, the legislature declares that it is the policy of the State of Illinois to encourage reductions in the generation of waste, in particular wastes generated in large volumes or exhibiting hazardous characteristics, whenever such reductions are technically and economically feasible. These reductions should take place in a manner that does not shift wastes from one environmental medium to another.

Recommendation 2: Form a State Industrial Waste Reduction Advisory Task Force

We recommend that a State Industrial Waste Reduction Advisory Task Force be formed to put the recommendations made in this chapter into the form of legislation. The Advisory Task Force should comprise representatives from government (e.g., Illinois Environmental Protection Agency, Department of Energy and Natural Resources, and Pollution Control Board), industry, and the environmental community. The Advisory Task Force should coordinate its activities with members of the Department of Energy and Natural Resources' Waste Reduction Task Force and may be partly composed of representatives of this group.

Recommendation 3: Develop New Reporting Requirements

There are many gaps in our knowledge about the types and amounts of waste generated in Illinois' industrial facilities. As was discussed in Chapter 3, present reporting requirements are not adequate to quantitatively assess the amount of waste reduced or the success of various waste reduction efforts. USEPA is exploring this issue at present. Only the USEPA Toxic Release Inventory contains data on multimedia releases of chemicals, and it covers only a portion of those releases. We need a better data collection system that links wastes to specific product outputs and industrial processes. We need more case studies of present waste reduction practices to determine which practices are successful and which are not. As this database develops, we will be able to regulate certain types of wastes more effectively and will be able to develop reasonable guidelines for implementing waste reduction techniques and technologies by production process, waste type and industry.

We recommend that the Advisory Task Force (see Recommendation 2) address this issue and make recommendations to the legislature on modifications and changes to the present reporting requirements. The Advisory Task Force should determine a method for amending the appropriate laws and regulations to collect these data and the resources needed by state agencies to track and analyze these data. In addition, certain aspects of the hazardous waste program would need to be addressed very carefully to ensure the integrity of USEPA's authorization of the Illinois program. These changes should allow policymakers to determine the level of waste reduction occurring in Illinois.

Recommendation 4: Develop Technical Assistance, Research, and Education Programs

Providing technical assistance and technical information is essential. HWRIC's technical assistance program is well utilized, and the Center has many documented successful case studies. IEPA and other agencies also provide help to generators, but more personnel and resources may be needed to reach the large number of waste generators in the state.

The state should further support its Toxic Pollution Prevention Act of 1989 by expanding the programs outlined in the Act and by providing the funding needed to implement the Act. This will be particularly necessary as firms implements mandatory waste audits, waste reduction plans and better data reporting requirements. Financial

resources to implement this recommendation may come from a fee levied on generators of waste, as discussed in Recommendation 8.

7.2.2 Direct Regulations

The mandatory waste audit and waste reduction plan recommended in this section are the regulatory policy options that offer the greatest potential for encouraging waste reduction in Illinois. As policymakers learn more about what each industrial group can reasonably achieve (by process and by waste type), they can develop more specific regulatory goals and guidelines. The mandatory waste audit and waste reduction plan recommended in this section should spell out a commitment and approach to reducing all wastes. The state may wish to focus more immediate attention on specific problem wastes. Under the state's current Toxic Pollution Prevention Program, IEPA is developing a list of chemicals that produce toxic emissions. The state may want to take more specific action to encourage the reduction of the chemicals on the list and, for some chemicals, encourage an eventual phase out of their use. We also recommend that the state target particular industrial categories for review of their progress in reducing waste. This could be done once every two years.

Recommendation 5: Mandate Waste Reduction Audits

The first step in developing a corporate waste reduction program must be a complete assessment of the wastes generated and the source of each waste. The best means to make this assessment is through a waste audit. A waste audit should look at the flow of all materials and the generation of all waste within an industrial facility and consider releases to all media to calculate the true cost of waste generation. The audit should consider compliance with pollution control regulations as well as waste reduction opportunities. It should serve as the basis for the facility-wide waste reduction plan discussed in Recommendation 6. USEPA and others have developed waste audit manuals, and most of these are available through the Hazardous Waste Research and Information Center. These manuals generally focus on hazardous waste streams, and they may have to be modified or new manuals may have to be developed to evaluate all industrial wastes. An audit checklist for analyzing the feasibility of various waste reduction techniques is included in Appendix B of this report.

We recommend mandating waste reduction audits for all large-quantity generators of hazardous waste under RCRA, all those who generate more than 1000 kg per month of

non-RCRA special waste, and all those subject to SARA Title III, Section 313. The audit should be conducted by a qualified engineer or team of specialists who can independently evaluate the sources of wastes and the potential for their reduction. The audit should identify a prioritized list of wastes to be targeted for reduction.

Recommendation 6: Mandate Waste Reduction Plans

Legislation should be enacted that requires the development of industrial waste reduction plans by large- and small-quantity generators of hazardous waste as defined under RCRA. The requirement should also cover all generators who manifest more than 1000 kg per month (in any one month during the year) of non-RCRA special waste, and all generators required to report releases under SARA Title III, Section 313. We have included small-quantity generators of hazardous waste in this requirement because they need to develop plans for the reduction of their wastes. Because the potential expense of audits may be burdensome for these generally smaller firms, we have excluded small-quantity generators from the audit requirements.

The Industrial Waste Reduction Advisory Task Force (see Recommendation 2) should formulate guidelines for the development of industrial waste reduction plans. The following requirements should be considered in formulating these guidelines:

1. A written policy articulating upper management and corporate support for the waste reduction plan and a commitment to implement plan goals.
2. Plan scope and objectives, including the evaluation of technologies, procedures, and personnel training programs to ensure unnecessary wastes are not generated and unnecessary toxic substances are not used. The plan should focus on wastes that pose the greatest potential hazard due to their hazardous characteristics, large volume, or difficult handling or disposal.
3. Periodic assessments of wastes including evaluating data on the types, quantities, and potential hazards of waste generated. The assessment should identify the waste-generating activity and potential reduction or recycling techniques applicable to each waste or material within the plant.
4. A waste and toxic use accounting system that identifies the costs of waste generation and management and factors in liability, compliance, oversight, spills, etc., to the extent technically and economically practicable.
5. Employee awareness and training programs to involve employees in waste reduction planning and implementation to the maximum extent feasible.
6. An implementation plan for carrying out technically and economically practicable waste reduction options. The plan should spell out the waste

reduction goals and a timetable for implementation. The first plan should include all programs in place and progress to date.

Although firms would not be required to submit these plans, the plans would be subject to audit by IEPA inspectors. If IEPA finds a plan is inadequate based on the guidelines established by the Waste Reduction Advisory Task Force, the generator should be subject to a fine. We recommend that industries required to develop a plan also be required to submit to the state their waste reduction goals and progress toward those goals. Past waste reduction accomplishments should be discussed in the first report to the state.

7.2.3 Economic Incentives

Generators determine how much waste reduction to implement based on the costs of implementing waste reduction relative to the costs of managing the wastes that are generated. Government policies that affect each of these costs can influence the amount of waste reduction that takes place. Grants and loans can reduce the costs of implementing waste reduction and therefore encourage the implementation of waste reduction techniques. Fees and taxes can encourage waste reduction by increasing the costs of managing wastes that are generated. We recommend that the State of Illinois pursue both these economic incentives, and that specific recommendations be made by the Waste Reduction Advisory Task Force.

Recommendation 7: Provide Grants and Loans

Chapter 3 showed that the most common reason facilities cited for not implementing waste reduction was that waste reduction was not economically viable. We recommend that the state help offset the costs of implementing waste reduction techniques. Grants to conduct research on new waste reduction techniques and technologies are important, but at present the demand greatly exceeds the resources available. Low-interest loans are also needed and could yield a substantial return to the state in the form of more efficient industrial facilities that make larger profits, pay additional taxes, maintain jobs or develop new ones, and better protect workers, neighboring residents, and the environment. The state should make grants and low-interest loans available to those industries that have demonstrated to IEPA a viable technology or technique for significantly reducing particular problem wastes.

Recommendation 8: Levy Fees and Taxes

Levying fees and taxes on waste generators in Illinois can serve two purposes. First, because fees and taxes increase the cost of generating waste, they can encourage facilities to implement waste reduction. Second, the proceeds from the fees and taxes can help fund the State's waste reduction programs. Unfortunately, these two objectives can contradict each other. If industry does successfully implement waste reduction, the proceeds from the fee or tax will decline, reducing the funds available for the state's waste reduction program. This conflict must be considered when determining funding and tax structures.

7.3 CONCLUSIONS

To encourage better industrial waste management the state needs to look more comprehensively at waste generation and the multimedia release of waste. IEPA is beginning to do this through some efforts at facility-wide permitting, where all regulatory programs (air, water and land) work together. Also, the Toxic Pollution Prevention Innovation Plan (Section 6 of the Toxic Pollution Prevention Act) allows IEPA to provide temporary variances from some environmental regulations to enable a company to institute and complete a pollution prevention project. Both of the above examples represent the types of innovations that will be needed to overcome some of the present hurdles to waste reduction.

We have shown that Illinois needs to develop a comprehensive framework to promote industrial waste reduction. Requiring firms to conduct waste audits and develop waste reduction plans is an important first step in Illinois' waste reduction program. The firm should designate a waste reduction manager or planner who has access to upper management, and their support, and who is responsible for implementing the program within an industrial facility. The state needs better data on the flow of chemicals in facilities, the wastes that are generated, and the degree of reduction that is taking place through various waste reduction strategies. As more waste reduction data become available, policymakers can propose additional measures to promote further progress in industrial waste reduction.

One policy option discussed in Chapters 5 and 6 that we have not recommended is the banning of certain chemicals. Unless a system is in place to fully evaluate the environmental and health effects of chemical substitutes, bans may create new problems

for the next generation. The advantages of a comprehensive waste reduction program is that it encourages a facility to evaluate the reduction or better management of all of its waste. To the extent that Illinois develops a comprehensive framework that addresses the movement of chemicals from raw materials to ultimate disposal, some of these potential future problems may be avoided.

Although this report addresses a number of policy options, including those that might be used to encourage the reduction of particular wastes or the use of particular techniques, we do not have adequate data at the present time to formulate policies this specific. In particular, we have few data on nonhazardous solid waste generated by industry. What we have recommended are the first stages of a program to address the reduction of all waste released to all media from an industrial facility. As policymakers develop better reporting requirements and more data become available, the State of Illinois can institute more specific requirements to reduce or recycle specific wastes.

REFERENCE

Auditor General, State of Illinois. 1989. *Management Audit of the Illinois Environmental Protection Agency's Hazardous Waste Program*. Springfield, IL: Office of the Auditor General.

APPENDIX A

HAZARDOUS WASTE REDUCTION ACT

HAZARDOUS WASTE REDUCTION ACT

This act is the result of a Council of State Governments Task Force created with the assistance of the U.S. Environmental Protection Agency and the Commonwealth of Kentucky. The project was conducted with the assistance of the staff of the Council's Suggested State Legislation Committee.

The purpose of the Task Force was to research state options and legislation on reducing the amounts of hazardous wastes and to prepare legislation. This act is therefore an combination of acts from several states, chiefly Kentucky, New York, Minnesota, North Carolina, and Oregon. To provide continuity, prevent duplication, and limit the subject matter, only parts of these acts were used.

The Task Force has identified three major actions (requiring waste reduction plans from generators; establishing a technical assistance center; and assessing fees on hazardous waste generators as a method to pay for such programs) for states to take to reduce the amounts of hazardous wastes produced within the state.

The primary intent of these recommendations is to reduce the amounts of hazardous wastes generated in a state. A secondary intent is to minimize the effect of the hazardous wastes that are produced. This act is intended to provide explicit statutory authority for (1) the agencies listed herein to assist businesses and other generators of hazardous wastes in reducing and minimizing their wastes; (2) to require hazardous waste generators to prepare and submit waste reduction plans; and (3) to collect fees on hazardous wastes.

CHAPTER 1

General Provisions

Section 1. [Short Title.] This act may be cited as the [state] Hazardous Waste Reduction Act of [year].

Section 2. [Definitions.]

(1) "Audit" or "waste audit" means an evaluation process at a facility, which examines the opportunities and potentials for implementing process modifications, materials substitutions, or more efficient management practices with respect to particular waste streams generated within the facility.

(2) "Generator" means any individual, business, government agency, or any other organization that generates hazardous waste as follows:

(a) "Fully regulated generator" means a generator who generates 2.2 pounds of acute hazardous waste as defined by 40 C.F.R. 261, or 2,200 pounds or more of hazardous waste in one month.

(b) "Small quantity generator" means any generator who generates between 220 and 2200 pounds of hazardous waste in one month.

(3) "Source reduction" or "waste reduction" means the elimination of waste at the source, usually within a process, including process modifications, feedstock substitutions, improvements in feedstock purity, housekeeping and management practices, increases in the efficiency of machinery and on-site, closed-loop recycling, or any action that reduces the amount and toxicity of the waste exiting the production process.

(4) "Waste" or "hazardous waste" means any hazardous waste as defined in [other state statutes], even though the waste may be within permitted or licensed limits.

Section 3. [Purpose, Goals and Intent.]

The [legislative body] finds that the timely development of a comprehensive hazardous waste reduction plan for the prevention and reduction of hazardous waste is essential to determine the scope and need for an off-site hazardous waste treatment facility.

The [legislative body] further finds that it is essential to ensure that the state fulfills its responsibilities under SARA, the Superfund Amendments and Reauthorization Act of 1986, Pub. L. No. 99-499, 100 Stat. 1613, as amended, to provide for the availability of adequate capacity for the management of hazardous waste by putting in place a comprehensive hazardous waste reduction plan. This plan should encourage source reduction and on-site treatment of hazardous waste and should reduce reliance on treatment and disposal facilities. Hazardous waste that is generated should be minimized, treated on-site, stored and disposed of so as to protect human health and the environment. The state should aid industry in meeting the goals and policies of this act through technical assistance.

It is the intent of the [legislative body] that the Capacity Assurance Plan (CAP), as required under SARA, should reflect the state's primary commitment to waste reduction and minimization through a combination of

technical assistance, economic incentives, education, and mandatory waste reduction regulations.

The [legislative body] declares it to be the policy of the state that, wherever feasible, the generation of hazardous waste is to be prevented or reduced as expeditiously as possible.

It is the purpose of this Act to prevent and reduce the generation of hazardous waste in the state. The state's goal is to reduce the generation and toxicity of waste that is generated within [state] by [percent] during the next [number] years. *[The original legislation's purpose was to reduce the volume of hazardous waste and permitted air and water discharges by 30%. No time frame was designated.]*

Section 4. [Waste Hierarchy Policy.]

It is the policy of [state] to adhere to the following hierarchy of waste prevention and management:

- (1) Reduce waste production at the source;
- (2) Recover and re-use resources (wastes);
- (3) Recycle on-site, or if that is not feasible, off-site;
- (4) Treat wastes to reduce volume and toxicity (including incineration);
- (5) Store wastes; and,
- (6) As a last resort, dispose of any remaining wastes in a manner which serves to protect the quality of air, water and land resources.

CHAPTER 2

State Waste Reduction Technical Assistance Program

Section 1. [Establish center for waste reduction.]

[State] hereby establishes a Center for Hazardous Waste Reduction at [a university, or within a state agency] for the purpose of assisting generators of hazardous waste to reduce the amounts, toxicity and adverse public health effects of waste produced. The Center shall provide the following services:

[Comment: The originating state established the center at a university.]

Section 2. [Powers and duties of center.]

1. Compile, organize, and make available for distribution information on hazardous waste reduction technologies and procedures;

2. Compile, and make available for distribution to business and industry, a list of expert private consultants on hazardous waste reduction technologies and procedures, and a list of researchers at state universities that could provide assistance in waste reduction activities;

3. Sponsor and conduct conferences and individualized workshops on hazardous waste reduction for specific classes of business or industry;

4. Conduct feasibility analyses for innovative hazardous waste reduction technologies and procedures;

5. Facilitate and promote the transfer of hazardous waste reduction technologies and procedures between businesses and industries;

6. Develop, where appropriate, and distribute for voluntary implementation, hazardous waste reduction plans for the major classes of business or industry that generate and subsequently treat, store, or dispose of hazardous waste in the state;

7. Develop, and make available for distribution, recommended hazardous waste audit procedures or protocols for utilization by business and industry in conducting internal hazardous waste audits;

8. Provide on-site assistance upon request to business and industry for the purpose of identifying potential techniques for waste reduction and assisting in conducting internal hazardous waste audits; *[Comment: this subsection is not compatible with Alternative Chapter 3 and will have to be deleted or re-written if Alternative Chapter 3 is selected for use.]*

9. Administer loan, loan guarantee, interest subsidy, or grant programs which may be established pursuant to law for the purpose of providing monies to a business or industry to subsidize the costs of conducting hazardous waste audits or waste reduction studies, or developing or purchasing, and implementing, hazardous waste reduction technologies and procedures, or for other similar purposes; *[Comment: this subsection is not compatible with Alternative Chapter 3 and will have to be deleted or re-written if Alternative Chapter 3 is selected for use.]*

10. Provide monies, from such funds as may be appropriated or otherwise made available, to academic institutions, businesses or industries, government agencies or private organizations located in the state to conduct demonstration or pilot programs utilizing innovative hazardous waste reduction technologies or procedures for specific categories of industry or business;

11. Provide monies, from such funds as may be appropriated or otherwise made available, to academic institutions or private organizations located in the state for basic or applied research on hazardous waste reduction;

12. Compile, and make available for distribution, information on available tax benefits for the implementation of hazardous waste reduction technologies and procedures by an industry or business;

13. Establish goals for voluntary hazardous waste reduction within the state, including the identification of key industries and businesses which should receive priority assistance from the center;

Comment: Those states adopting Section 3 of Chapter 1 should revise the above language to conform to the amount of the goal established.

14. Identify governmental and nongovernmental impediments to hazardous waste reduction;

15. Develop the necessary information base and data collection programs to assist in establishing program priorities and evaluating the progress of reducing hazardous wastes;

16. Develop training programs and materials for state and local regulatory personnel and private industry designed to inform them about waste reduction practices and their applicability to industry;

17. Produce a biennial report on the center's activities, achievements, problems identified and future goals, including a biennial work plan;

18. Participate in existing state, federal and industrial networks of individuals and groups actively involved in waste reduction activities;

19. Seek outstanding examples of success in reducing hazardous wastes and recommend to the Governor nominees for awards in waste reduction; and,

20. Publicize to business and industry and participate in and support waste exchange programs.

CHAPTER 3 Waste Reduction Plans

Section 1. [Guidelines for Generator Waste Reduction Plans.]

(1) Not later than [date] the [appropriate regulatory authority, hereinafter referred to as "department"] shall establish guidelines for hazardous waste reduction plans to be prepared by generators. At a minimum, the guidelines should include:

a) A written policy articulating upper management and corporate support for the generator's hazardous waste reduction plan and a commitment to implement plan goals.

(b) Plan scope and objectives, including the evaluation of technologies, procedures and personnel training programs to insure unnecessary waste is not generated. In addition to the goals required in subsection (2) of this section, specific goals may be set for hazardous waste reduction, based on the department's assessment of what is technically and economically practical.

(c) Internal analysis of hazardous waste streams, with periodic hazardous waste reduction assessments, to review individual processes or facilities and other activities where waste may be generated and identify opportunities to reduce or eliminate waste generation. Such assessments shall evaluate data on the types, amount and hazardous constituents of waste generated, where and why that waste was generated within the production process or other operations, and potential hazardous waste reduction and recycling techniques applicable to those wastes.

(d) Hazardous waste accounting systems that identify waste management costs and factor in liability, compliance and oversight costs to the extent technically and economically practical.

(e) Employee awareness and training programs, to involve employees in hazardous waste reduction planning and implementation to the maximum extent feasible.

(f) Institutionalization of the plan to insure an ongoing effort as demonstrated by incorporation of the plan into management practices and procedures.

(g) Implementation of technically and economically practical hazardous waste reduction options, including a plan for implementation. This shall include a description of options considered and an explanation of why options considered were not implemented.

(2) As part of each plan developed under section 2 of this Act, a generator shall establish specific performance goals for the reduction of waste; namely, for fully regulated generators, any waste representing 10 percent or more by weight of the cumulative waste stream generated per year.

(3) Wherever technically and economically practical, the specific performance goals established under subsection (2) of this section shall be expressed in numeric terms. If the establishment of numeric performance goals is not practical, the performance goals shall include a clearly stated list of objectives designed to lead to the establishment of numeric goals as soon as practical.

(4) Each generator shall explain the rationale for each performance goal. The rationale for a particular performance goal shall address any impediments to hazardous waste reduction, including but not limited to the following:

(a) The availability of technically practical hazardous waste reduction methods, including any anticipated changes in the future.

(b) Previously implemented reductions of waste.

(c) The economic practicability of available hazardous waste reduction methods, including any anticipated changes in the future. Examples of situations where hazardous waste reduction may not be economically practical include but are not limited to:

(A) For valid reasons of prioritization, a particular company has chosen first to address other more serious hazardous waste reduction concerns;

(B) Necessary steps to reduce hazardous waste are likely to have significant adverse impacts on product quality; or

(C) Legal or contractual obligations interfere with the necessary step that would lead to hazardous waste reduction.

(5) All generators shall complete annually a hazardous waste reduction progress report.

(6) An annual progress report shall:

(a) Analyze and quantify progress made, if any, in hazardous waste reduction, relative to each performance goal established under subsection (2) of this section; and

(b) Set forth amendments to the hazardous waste reduction plan and explain the need for the amendments.

(7) The department, by rule, may provide for modifications for small-quantity generators related to the kind of information to be included in the plan.

Section 2. [Waste Reduction Plan.]

(1) All large users and fully regulated generators shall complete a hazardous waste reduction plan on or before [date], *[Comment: In the original legislation, three years was provided.]* and all small-quantity generators shall complete a hazardous waste reduction plan on or before [date]. *[Comment: In the original legislation, four years was provided.]* Upon completion of a plan, the user shall notify the department in writing on a form supplied by the department.

(2) A facility required to complete a hazardous waste reduction plan under subsection (1) of this section may include as a preface to its initial plan:

(a) An explanation and documentation regarding hazardous waste reduction efforts completed or in progress before the first reporting date; and

(b) An explanation and documentation regarding impediments to hazardous waste reduction specific to the individual facility.

(3) The department shall consider information provided under subsection (2) of this section in any review of a facility plan under section 3 of this Act.

(4) Except as provided in section 3 of this Act, a hazardous waste reduction plan developed under this section shall be retained at the facility and shall not be considered a public record under [statute].

(5) For the purposes of this section and section 3 of this Act, a generator shall permit the director or any designated employee of the director to inspect the hazardous waste reduction plan.

(6) A facility shall determine whether it is required to complete a plan under subsection (1) of this section based on whether its waste generation results in the facility meeting the definition of generator as defined in chapter 1 of this Act for the calendar year ending December 31 of the year immediately preceding the reporting deadline as defined in this section.

Section 3. [Review and Approval of Plan.]

(1) The department may review a plan or an annual progress report to determine whether the plan or progress report is adequate according to the guidelines established under section 1 of this Act. If a generator fails to complete an adequate plan or annual progress report as required under this Act,

the department may notify the user of the inadequacy, identifying the specific deficiencies. The department also may specify a reasonable time frame, of not less than 90 days, within which the generator shall submit a modified plan or progress report addressing the specified deficiencies. The department shall upon request make technical assistance available to aid the generator in modifying its plan or progress report.

(2) If the department determines that a modified plan or progress report submitted pursuant to subsection (1) of this section is inadequate, the department may, within its discretion, either require further modification or issue an administrative order pursuant to subsection (3) of this section.

(3) If after having received a list of specified deficiencies from the department, a generator fails to develop an adequate plan or progress report with a time frame specified pursuant to subsection (1) or (2) of this section, the department may order such generator to submit an adequate plan or progress report within a reasonable time frame of not less than 90 days. If the generator fails to develop an adequate plan or progress report within the time frame specified, the department shall conduct a hearing on the plan or progress report. Except as provided under section 8 of this Act, in any hearing under this section the relevant plan or progress report shall be considered a public record as defined in [statute].

(4) In reviewing the adequacy of any plan or progress report, the department shall base its determination solely on whether the plan or progress report is complete and prepared in accordance with section 1 of this chapter.

(5) The department shall maintain a log of each plan or progress report it reviews, a list of all plans or progress reports that have been found inadequate under subsection (3) of this section and descriptions of corrective actions taken. This information shall be available to the public at the department's office.

Section 4. [Annual Generator Report.]

(1) From each annual progress report, the generator shall report to the department the quantities of hazardous wastes generated that are within the categories set forth in subsection (2) of section 1 of this Act.

(2) The report shall include a narrative summary explaining the data. The narrative summary may include:

(a) A description of goals and progress made in reducing the generation of hazardous waste; and

(b) A description of any impediments to reducing the generation of hazardous waste.

(4) The department, by rule, shall develop uniform reporting requirements for the data required under subsection (1) of this section.

(5) Except for the information reported to the department under this

section, the annual progress report shall be retained at the facility and shall not be considered a public record under [statute]. However, the generator shall permit any officer, employee or representative of the department at all reasonable times to have access to the annual progress report.

Section 5. [Dates reports due.]

Fully regulated generators shall complete the first annual progress report required under section 1 of this Act on or before [date]. Small-quantity generators shall complete the first annual progress report required under section 1 of this Act on or before [above date, plus one year].

Section 6. [Coordination with technical assistance center.]

Subject to available funding, the department shall contract with the technical information center to assist the department in carrying out the provisions of this Act. The assistance shall emphasize strategies to encourage hazardous waste reduction and shall provide assistance to facilities under this Act.

Section 7. [Advisory committee.]

(1) In order to assist in establishing rules related to hazardous waste reduction, the department shall establish an advisory committee. The advisory committee shall consist of representatives of the public and affected industries.

(2) The advisory committee shall act in an advisory capacity to the department in any matter related to hazardous waste reduction. The advisory committee may provide comments regarding data collection, plan format and content. In addition, the committee shall identify any additional data necessary to improve the technical assistance process, to develop plans and to aid in enforcement of plans.

(3) The committee also may identify specific chemicals that present the greatest hazard to the public health and safety, and the environment in order that the department may focus technical assistance, research and development efforts to facilitate accelerated reduction in the generation of such waste chemicals.

(4) The committee shall make recommendations to the department to facilitate the coordination of requirements of all state and federal hazardous waste programs, including but not limited to the Clean Air Act, the Federal Water Pollution Control Act, the Toxic Substances Control Act, the Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation, and Liability Act, and any amendments thereto, Title III of the Superfund Amendments and Reauthorization Act of 1986 and amendments thereto, the [state] Community Right-to-Know and Protection Act of [date].

(5) The committee shall make recommendations under this section on or before [date]. *[Comment: In the original legislation, one and one-half years was provided.]*

Section 8. [Confidentiality.]

(1) Upon a showing satisfactory to the director by any person that a plan or annual progress report developed under this Act, or any portion thereof, if made public, would divulge methods, processes or other information entitled to protection as trade secrets, as defined under [Statute], of such person, the director shall classify as confidential such plan or annual progress report, or portion thereof.

(2) To the extent that any plan or annual progress report under subsection (1) of this section, or any portion thereof, would otherwise qualify as a trade secret under [statute], no action taken by the director or any authorized employee of the department in inspecting or reviewing such information shall effect its status as a trade secret.

(3) Any information classified by the director as confidential under subsection (1) of this section shall not be made a part of any public record, used in any public hearing or disclosed to any party outside of the department unless a circuit court determines that evidence is necessary to the determination of an issue or issues being decided at the public hearing.

Section 9. [Report to the legislature.]

On or before [date], the department shall report to the legislative assembly on the status of implementing this Act. This report shall include information regarding:

- (1) The status of the technical assistance program;
- (2) Progress toward reducing the quantities of hazardous wastes generated in [State]; and
- (3) An analysis and recommendations for changes to the program including but not limited to the need for any additional enforcement provisions.

ALTERNATIVE: CHAPTER 3

Small Quantity Generator Hazardous Waste Audit Program

[This alternative is provided for those states wishing to establish a more limited program for waste reduction plans than described in Chapter 3 above. The focus of this program is on small quantity generators.]

Section 1. [Creates small quantity generator hazardous waste audit program].

The department shall establish and be responsible for a small quantity generator hazardous waste audit program. To carry out such program, the department is authorized to obtain the services, as necessary, of waste management specialists to conduct waste audits at the facilities of hazardous waste generators that have produced less than one thousand kilograms of hazardous waste in each of the past twelve calendar months. The purpose of such audits shall be to provide on-site technical assistance to aid such generators in complying with the state's hazardous waste regulations and to identify and evaluate the potential for reducing the amount and/or toxicity of hazardous waste generated at such facilities.

Section 2. [Scope of waste audits.]

Waste audits conducted pursuant to this subdivision may include, but need not be limited to:

- (a) identification of all hazardous wastes generated at the facility;
- (b) identification of the regulatory requirements associated with the storage, treatment, or disposal of all hazardous wastes generated at the facility;
- (c) identification of any methodologies, processes, equipment, or production changes which could be utilized by the facility to reduce the amount or toxicity of hazardous wastes generated at the facility;
- (d) identification of any on-site recycling or waste treatment technologies which could be utilized to reduce the amount or toxicity of hazardous wastes disposed of by the facility; and
- (e) identification of any potential markets for hazardous waste generated by the facility, including the use of waste exchange markets.

Section 3. [Fee schedule.]

The department shall establish by rule and regulation, upon consultation with the [director of the budget], a sliding fee schedule to offset the costs of conducting on-site audits. The fee schedule established pursuant to this section shall be intended to provide revenues sufficient to meet solely the costs incurred by the department in performing such audits, provided that the department may use technical assistance grants it receives from the federal government, private foundations, or other institutions to reduce or eliminate fees charged generators for performing such audits, and further provided that monies appropriated to the department to carry out the purposes of this subsection shall not be used to provide financial assistance to waste generators for the purchase of manufacturing plants or equipment, property, real or otherwise, engineering or legal services, or any other cost incident to the actual implementation of a waste reduction or management project. The chairman of the department is authorized and directed to deposit all monies received in payment of fees under this subdivision in an account within the miscellaneous special revenue fund.

Section 4. [Corrections plan.]

Any person receiving audit services pursuant to this subdivision shall, within ninety days of the completion of such audit, submit to the department a description of the steps it will take, if any, to implement any recommended waste reduction, recycling, or treatment strategies identified in such audit.

Section 5. [Authorization.]

In implementing the small quantity generator hazardous waste audit program, the department is authorized to:

- (a) hire or contract with an appropriate number of hazardous waste management specialists to conduct on-site waste audits.
- (b) employ such public information methods as are appropriate to identify and inform eligible hazardous waste generators of the existence of the waste audit program;

(c) establish a small quantity generator hazardous waste audit program application consistent with the policies and goals of this section; and

(d) establish by rule and regulation a small quantity generator hazardous waste audit program application evaluation procedure consistent with the policies and goals of this section.

CHAPTER 4 Hazardous Waste Fees

Section 1. [Fee Schedules.]

(a) The department shall establish the fees provided in Sections 2 and 3 in the manner provided in [other state statutory references concerning establishment of fees] to cover the amount appropriated in [departmental appropriation statute] to the department for permitting, monitoring, inspection, enforcement, waste reduction plan activities and technical assistance center expenses of the department.

(b) The legislature may appropriate additional amounts from the general fund that need not be covered by the fees, in order to assure adequate funding for the regulatory and enforcement functions of the department related to hazardous waste. All fees collected by the department under this section shall be deposited in the [indicate type] fund.

Section 2. [Hazardous Waste Generator Fee.]

(a) Each generator of hazardous waste shall pay a fee on the hazardous waste which it generates. The department shall compute the amount of the fee due based on the hazardous waste disclosures submitted by the generators and other information available to the department. The department shall annually prepare a statement of the amount of the fee due from each generator. The fee shall be paid annually commencing with the first day of the calendar quarter after the day of the statement.

(b) The department may exempt generators of small quantities of hazardous wastes otherwise subject to the fee if it finds that the cost of administering a fee on those generators is excessive relative to the proceeds of the fee. The fee shall consist of a minimum fee for each generator not exempted by the department and an additional fee based on the quantity of wastes generated by the generator.

(c) If any metropolitan counties recover the costs of administering county hazardous waste regulations by charging fees, the fees charged by the department outside of those counties shall not exceed the fees charged by those counties. The department shall not charge a fee in any metropolitan county which charges such a fee. The department shall impose a fee calculated as a surcharge on the fees charged by the metropolitan counties and by the department to reflect the department's expenses in carrying out its statewide hazardous waste regulatory responsibilities. The surcharge imposed on the fees charged by the metropolitan counties shall be collected by the metropolitan counties in the manner in which the counties collect their generator fees. Metropolitan counties shall remit the proceeds of the surcharge to the

department by the last day of the month following the month in which they were collected.

Section 3. [Facility fees.]

(a) The department shall charge an original permit fee, a reissuance fee and an annual operator's fee for any hazardous waste facility regulated by the department. The department may include reasonable and necessary costs of any environmental review required under [statute] in the original permit fee for any hazardous waste facility.

Section 4. [Approval.]

Fees for accounts for which appropriations are made may not be established or adjusted without the approval of the director. If the fee or fee adjustment is required by law to be fixed by rule, the director's approval must be in the statement of need and reasonableness. These fees must be reviewed each fiscal year. Unless the director determines that the fee must be lower, fees must be set or fee adjustments must be made so the total fees nearly equal the sum of the appropriation for the accounts plus the department's general support costs, statewide indirect costs, and attorney general costs attributable to the fee function.

APPENDIX B

**WASTE REDUCTION AUDIT CHECKLIST (WRAC)
QUESTIONNAIRE**

THE WASTE REDUCTION AUDIT CHECKLIST (WRAC) QUESTIONNAIRE

from the

WASTE REDUCTION ADVISORY SYSTEM (WRAS)

Illinois Hazardous Waste Research and Information Center
Department of Energy and Natural Resources
1808 Woodfield Drive
Savoy, Illinois 61874

in cooperation with

National Roundtable of State Waste Reduction Programs
User's and Technical Information Board

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User # _____

WASTE REDUCTION AUDIT CHECKLIST (WRAC)

Version 2.3 January 1, 1990

INTRODUCTION

The Waste Reduction Audit Checklist is comprised of groups of questions on eleven waste reduction techniques or topics. The twelfth topic contains a description of some technical assistance services and information available to help you evaluate waste reduction opportunities. The WRAC is based on current knowledge of incentives and opportunities for waste reduction for specific industry experiences.

WASTE REDUCTION DEFINITION

Waste reduction refers to decreasing the quantity or toxicity of wastes generated so that less will need to be treated, stored, or disposed of. All wastes -- solids, sludges, liquids, vapors -- are considered in a waste reduction program. Waste reduction can be practiced at several stages in industrial processes.

The prime requirement for a successful waste reduction program is the commitment of company management. Careful planning, creative problem solving, changes in attitude, and sometimes capital investment, are always required.

BENEFITS OF COMPLETING THE WASTE REDUCTION AUDIT CHECKLIST

By completing this checklist, you will accomplish the following:

- Assess what waste reduction activities are currently underway within your company;
- Identify potential waste reduction techniques for each of your waste generating processes or job operations; and
- Determine the steps to obtain waste reduction assistance.

GENERAL INSTRUCTIONS

You are provided a definition for each waste reduction technique followed by groups of questions for you to answer. After each question follow the instructions in **CAPITAL LETTERS AND BOLD PRINT**.

Always go to the next question, unless there are instructions to skip to another question.

Please answer all questions so that it is clear the question was not inadvertently missed.

USER IDENTIFICATION

What is the SIC code for the industry group to which you belong? **RECORD YOUR 4-DIGIT SIC CODE: SIC CODE #** _ _ _ _

TECHNIQUE I: MANAGEMENT STRATEGIES

The support and leadership of company management is necessary for waste reduction to be successful. For example, components of the E.I. du Pont de Nemours and Company's waste reduction program include:

- establishment of targets for waste reduction;
- assignment of appropriate levels of technical resources to accomplish goals; and
- creation of a system to track and report on performance.

Other management strategies can include: 1) providing employee training and incentive programs (monetary rewards and/or recognition), and 2) using inventory control systems and purchasing procedures to minimize the waste generated from excess, off-spec, and past-shelf-life materials.

Each of these topics is covered under the general technique of MANAGEMENT STRATEGIES.

1. Does your company have either a formal or informal corporate or management waste reduction policy? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Yes, our company has a formal waste reduction policy.
☐ Yes, our company has an informal waste reduction policy.
☐ No, our company has not yet established a formal or informal waste reduction policy.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

2. Employee training and incentive programs can reduce waste generation, handling, and disposal costs. Has your company implemented training programs to inform your employees about proper waste management techniques, including waste reduction, or implemented incentive programs that reward your employees for their suggestions on ways to reduce waste and generate cost savings at your facilities? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Implemented training programs in waste handling or management.
☐ Implemented training programs in waste reduction.
☐ Implemented incentive programs (monetary rewards and/or recognition) for waste reduction and cost savings.

Other **SPECIFY:** _____

☐ **NO**, our company does not have a training or incentive program.
(SKIP TO Q. 4)

☐ **DON'T KNOW.** **(SKIP TO Q. 4)**

3. What have been the results of training and incentive programs on waste generation and cost savings implemented by your company? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Reduced waste generation and handling costs.
- ☐ No reduction in waste generation and handling costs.
- ☐ Under our incentive program, employees have made valuable waste reduction suggestions that have been implemented.
- ☐ Employees have made waste reduction suggestions under our incentive program, but they have not been implemented.
- ☐ Employees have not responded to the incentive program.

Other **SPECIFY:** _____

**DON'T KNOW.
RESULTS HAVE NOT BEEN EVALUATED.**

4. Does your company have an inventory control system and/or purchasing procedures that minimize the waste generated from excess, off-spec, and past-shelf-life materials? **CHECK ALL ANSWERS THAT APPLY.**

- Yes, an inventory control system is in place.
- Yes, our company uses purchasing procedures to reduce stock on hand.

Other **SPECIFY:** _____

- NO**, our company does not have an inventory control system
or purchasing procedures designed to reduce waste. (SKIP TO Q.6)
- DON'T KNOW.** (SKIP TO Q.6)

5. What have been the results of the inventory control and purchasing procedures at your facility? **CHECK ALL ANSWERS THAT APPLY.**

- Reduced amounts of off-spec materials.
- Reduced amounts of past-shelf-life materials.
- Reduced purchase of excess quantities of materials.

Other **SPECIFY:** _____

**DON'T KNOW.
— RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE II**

TECHNIQUE I: MANAGEMENT STRATEGIES

The support and leadership of company management is necessary for waste reduction to be successful. For example, components of the E.I. du Pont de Nemours and Company's waste reduction program include:

- establishment of targets for waste reduction;
- assignment of appropriate levels of technical resources to accomplish goals;
- and
- creation of a system to track and report on performance.

Other management strategies can include: 1) providing employee training and incentive programs (monetary rewards and/or recognition), and 2) using inventory control systems and purchasing procedures to minimize the waste generated from excess, off-spec, and past-shelf-life materials.

Each of these topics is covered under the general technique of MANAGEMENT STRATEGIES.

1. Does your company have either a formal or informal corporate or management waste reduction policy? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Yes, our company has a formal waste reduction policy.
☐ Yes, our company has an informal waste reduction policy.
☐ No, our company has not yet established a formal or informal waste reduction policy.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

2. Employee training and incentive programs can reduce waste generation, handling, and disposal costs. Has your company implemented training programs to inform your employees about proper waste management techniques, including waste reduction, or implemented incentive programs that reward your employees for their suggestions on ways to reduce waste and generate cost savings at your facilities? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Implemented training programs in waste handling or management.
☐ Implemented training programs in waste reduction.
☐ Implemented incentive programs (monetary rewards and/or recognition) for waste reduction and cost savings.

Other **SPECIFY:** _____

☐ **NO**, our company does not have a training or incentive program.
(SKIP TO Q. 4)

☐ **DON'T KNOW.** **(SKIP TO Q. 4)**

6. Why hasn't your company established management strategies for waste reduction? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We do not have information on or examples of management strategies to reduce waste.
- ☐ We do not have enough personnel or other resources for employee training or incentive programs.
- ☐ Lack of corporate commitment or company policy.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

TECHNIQUE II: WASTE REDUCTION AUDITS

A waste reduction audit consists of a thorough review of all materials handling and waste-generating activities in a facility. The goal of a waste reduction audit is to identify ways that waste and costs can be reduced. It differs from an environmental audit in that regulatory compliance, such as evaluation of the need for an National Pollutant Discharge Elimination System (NPDES) permit, is not a primary objective. In a waste reduction audit, determinations are made of

- the kinds of waste that are generated;
- how much of each type of waste is generated;
- how wastes are generated;
- how often wastes are generated;
- how wastes are managed; and
- waste management costs.

These data are then used to identify and prioritize waste reduction options. The data analysis may include evaluation of capital and operating costs.

7. Has your company ever performed, or had performed, a waste reduction audit?
CHECK ONLY ONE ANSWER.

- ☐ Yes. (GO TO Q. 8)
- ☐ No. (SKIP TO Q.9)
- ☐ **DON'T KNOW.** (SKIP TO Q.9)

8. What were the results of your waste reduction audit? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We identified some waste reduction options.
- ☐ We implemented some or all of the waste reduction options that were identified.
- ☐ Benefits resulted from implementing the waste reduction options (benefits could include reduced waste management costs, fewer waste handling problems, less employee exposure to hazardous substances, etc.).
- ☐ No waste reduction options were identified.
- ☐ The waste reduction audit was not completed.
- ☐ The results of the audit were difficult to evaluate.
- ☐ The waste reduction recommendations were not implemented.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE
III**

9. Why haven't you performed a waste reduction audit? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We did not have information on how to conduct a waste reduction audit.
- ☐ We do not have enough personnel or other resources.
- ☐ A waste reduction audit is not warranted because our plant layout is simple or we have a limited number of waste streams, etc.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**

TECHNIQUE III: BETTER HOUSEKEEPING

Better housekeeping involves the use of improved operating practices to reduce spills, overflow, leakage, and other inefficiencies. These practices will often increase profits with little or no capital outlay.

For example, the installation of splash guards between a plating tank and a succeeding rinse tank will usually help prevent accumulation of dripped plating solution on the floor between tanks. Guards will drain any dripping solution into either the plating or rinse tank for reuse.

10. Which of the following housekeeping practices does your company use to reduce waste generation? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We use lids and splash guards to prevent cross-contamination.
- ☐ We have developed operational procedures to prevent spills.
- ☐ We have regular equipment maintenance to prevent dirt and fouling from contaminating process fluids.
- ☐ We have a preventive maintenance program for pump seals, valves, etc.
- ☐ The amount of waste kept in storage is minimized.

Other **SPECIFY:** _____

- ☐ **NOT APPLICABLE.** (SKIP TO Q. 12)
- ☐ **DON'T KNOW.** (SKIP TO Q. 12)

11. What have been the results of better housekeeping practices implemented at your facility? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Reduced waste generation.
- ☐ Reduced waste management costs.
- ☐ Operators follow the guidelines.
- ☐ Operators do not follow the guidelines.
- ☐ Waste management costs were not reduced.
- ☐ The quantity of waste produced was not reduced.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE
IV**

12. Why haven't you implemented housekeeping practices to reduce waste generation? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We lack personnel or other resources.
- ☐ More specific information is needed for our situation.

Other **SPECIFY:** _____

- ☐ **NOT APPLICABLE.**
- ☐ **DON'T KNOW.**

TECHNIQUE IV: WASTE STREAM SEGREGATION

When hazardous (or regulated) process waste streams are combined with non-hazardous (or non-regulated) waste streams, the resulting waste is considered to be hazardous. With waste stream segregation, hazardous and non-hazardous waste streams are kept separate, thus minimizing waste management problems. Chlorinated and non-chlorinated organic wastes should be kept separate. In some cases, plant managers have found that their hazardous waste stream accounted for less than 10% of the total amount of waste that was being generated and **combined** for disposal.

For example, an electroplater who uses cyanide may wish to segregate the cyanide waste streams from those that are cyanide-free. This will yield tighter control of the cyanide destruction, and reduce wastewater treatment costs. Another potential benefit of waste segregation is that it may allow you to recycle some of the waste streams within your own facility (see Technique X). Some of the waste streams may also be of value through exchange or sale with others (see Technique XI).

13. Does your company segregate wastes in order to reduce the generation of regulated wastes or wastes that are difficult to recycle or treat? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Regulated wastes are segregated from non-regulated wastes (e.g., paper).
- ☐ More toxic or difficult to treat wastes are segregated from less toxic or difficult wastes (e.g., cyanide bearing, chrome bearing).
- ☐ Organic wastes are kept separate from metallic wastes and other inorganic wastes.
- ☐ Chlorinated solvent wastes are segregated from non-chlorinated solvent wastes.
- ☐ Wastes that can be recycled are kept separate from those that cannot be recycled.

Other **SPECIFY:** _____

- ☐ **OUR WASTES ARE NOT SEGREGATED.** (SKIP TO Q. 15)
- ☐ **DON'T KNOW.** (SKIP TO Q. 15)

14. What have been the results of waste stream segregation at your plant? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Decreased volume of wastes generated.
- ☐ Lower treatment costs.
- ☐ Lower disposal costs.
- ☐ Wastes that were previously treated or disposed of are now recycled onsite.
- ☐ Wastes that were previously treated or disposed of are now exchanged with another company or plant.
- ☐ No observed benefits.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE V**

15. Why hasn't your company implemented waste stream segregation measures?
CHECK ALL ANSWERS THAT APPLY.

- ☐ Major capital investment would be required.
- ☐ We are unsure of the feasibility of recycling or reusing the segregated waste streams.
- Other **SPECIFY:** _____
- _____
- _____
- ☐ **DON'T KNOW.**

TECHNIQUE V: PROCESS RAW MATERIALS SUBSTITUTION OR MODIFICATION

Non-hazardous or less toxic materials can sometimes be substituted for hazardous materials to reduce or eliminate hazardous waste generation. Decreasing employee exposure to these wastes is another possible benefit of material substitution, for example, using less toxic solvents in degreasing operations. Some companies have found that their operations and products have improved after the substitution.

Process raw material substitutions can also be made to reduce the quantity of non-hazardous wastes generated. For example, sodium hydroxide can often be substituted for lime in wastewater neutralization. Sodium hydroxide produces only one-tenth as much sludge (dry weight) in some operations. In this case, higher raw material costs are more than offset by lower waste management and disposal costs.

16. Do you know which process raw materials (e.g., solvents, paints, cyanides) currently used at your facility could be replaced in order to reduce the amount or toxicity of by-products and wastes generated? **CHECK ONLY ONE ANSWER.**

- ☐ Yes, I am aware of substitute materials.
Which materials? **SPECIFY:** _____
- _____
- _____
- ☐ No, I do not know of any substitute materials.
- ☐ **NOT APPLICABLE.**

17. Have you used process raw material substitution at your facility? **CHECK ONLY ONE ANSWER.**

- ☐ Yes. (GO TO Q. 18)
- ☐ No. (SKIP TO Q. 19)
- ☐ **NOT APPLICABLE.** (SKIP TO Q. 19)
- ☐ **DON'T KNOW.** (SKIP TO Q. 19)

18. What have been the results of process raw material substitutions at your facility?

CHECK ALL ANSWERS THAT APPLY.

- ☐ Waste management costs were reduced.
- ☐ Waste management costs were not reduced.
- ☐ Operating costs were reduced.
- ☐ Operating costs were not reduced.
- ☐ Product quality improved or did not decline.
- ☐ Product quality declined.
- ☐ No operating problems resulted from the substitution.
- ☐ Operating problems occurred but were resolved.
- ☐ We have continuing operating problems that resulted from changes in our process raw materials.
- ☐ We went back to the original material.
- ☐ Our operators approve of the change.
- ☐ Our operators do not like the change.
- ☐ Employees not exposed to as much toxic material.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE
VI**

19. What are the reasons you have not tried process raw material substitution in your facility? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Lack of information about suitable substitute materials for our processes.
- ☐ Concern for product quality.
- ☐ Resistance from operators or engineers.
- ☐ Increased material costs with uncertain benefits.
- ☐ Difficulties in getting our wastes delisted.

Other **SPECIFY:** _____

- ☐ **NOT APPLICABLE.**
- ☐ **DON'T KNOW.**

TECHNIQUE VI: PRODUCT REFORMULATION OR REDESIGN

Some products can be reformulated to reduce or eliminate the need to use hazardous or toxic materials. Product reformulation can also reduce or eliminate the generation of hazardous wastes or by-products.

20. Do you know if any of your products could be reformulated or redesigned to reduce the need to use hazardous material(s) or to reduce the amount or toxicity of hazardous wastes that are generated? **CHECK ONLY ONE ANSWER.**

- ☐ Yes, for several or all products.
- ☐ Yes, for some products.
- ☐ Perhaps, but needs review.
- ☐ No.
- ☐ **NOT APPLICABLE.**
- ☐ **DON'T KNOW.**

21. Have you ever reformulated a product to reduce the amount or toxicity of the wastes or by-products you generate? **CHECK ONLY ONE ANSWER.**

- ☐ Yes. (GO TO Q. 22)
- ☐ No. (SKIP TO Q. 23)
- ☐ **NOT APPLICABLE.** (SKIP TO Q. 23)
- ☐ **DON'T KNOW.** (SKIP TO Q. 23)

22. What have been the results of product reformulation(s) implemented by your company? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Waste management costs were reduced.
- ☐ Waste management costs were not reduced.
- ☐ Operating costs were reduced.
- ☐ Operating costs were not reduced.
- ☐ Product quality improved or did not decline.
- ☐ Product quality declined.
- ☐ Our customers approved of or did not notice the change.
- ☐ Our customers have complained about the change.
- ☐ We have no operating problems resulting from the reformulation or redesign.
- ☐ Operating problems resulting from the change have been resolved.
- ☐ Continuing reformulation problems have resulted.
- ☐ Our operators approve of the change.
- ☐ Our operators disapprove of the change.
- ☐ Employees not exposed to as much toxic material.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE
VII**

23. What are the reasons you have not reformulated or redesigned a product to reduce your waste generation? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Management does not believe the risks are worth the potential benefits.
- ☐ Fear of customer dissatisfaction.
- ☐ Benefit uncertainties.
- ☐ Operator or engineer resistance.
- ☐ Lack of information.

Other **SPECIFY:** _____

- ☐ **NOT APPLICABLE.**
- ☐ **DON'T KNOW.**

TECHNIQUE VII: EQUIPMENT OR TECHNOLOGY MODIFICATION

Modifications in equipment or technology can be useful in reducing the amount or toxicity of wastes that are generated. Modifications can entail changing material flows or substituting more efficient equipment.

For example, some commercial spray painting shops are switching from conventional spray painting to electrostatic spray painting. In an electrostatic spray painting operation the paint is given a positive charge while the object to be painted is given a negative charge; therefore, each drop of paint is attracted toward the object being painted. By using electrostatic spray painting, a shop can increase paint transfer efficiency to over 90%, whereas the conventional spray painting operation affords only 30% paint transfer efficiency. Additionally, the electrostatic process uses one-third as much paint as conventional spray painting.

24. Has your company done any of the following? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Considered waste reduction when purchasing new equipment.
- ☐ Modified equipment to reduce waste generation.
- ☐ Replaced equipment to reduce the amount of waste that is generated.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

(SKIP TO Q. 26)

25. What have been the results of the equipment or technology modification(s) you have tried? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ The volume of waste generated was reduced.
- ☐ The volume of waste generated stayed about the same.
- ☐ The volume of waste generated increased.
- ☐ The toxicity or hazard of wastes generated was reduced.
- ☐ The toxicity or hazard of wastes generated stayed about the same.
- ☐ The toxicity or hazard of wastes generated increased.
- ☐ Overall cost savings were realized.
- ☐ Overall costs stayed about the same.
- ☐ Costs increased.
- ☐ We were able, or have applied, to get our waste delisted.

Other **SPECIFY:** _____

☐ **DON'T KNOW**
☐ **RESULTS HAVE NOT BEEN EVALUATED.**

26. What barriers have you encountered when considering or implementing an equipment or technology modification? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Inability to find suitable equipment vendors.
- ☐ Commercial processes that reduce waste generation are not available for our situation.
- ☐ We do not have enough information.
- ☐ We cannot commit enough personnel or other resources.
- ☐ Major capital investment would be required.
- ☐ We are unsure of the effect such changes would have on our product quality.
- ☐ Our studies indicate that the costs outweigh the benefits.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

TECHNIQUE VIII: PROCESS MODIFICATION OR SUBSTITUTION

Processes and related procedures can be modified to reduce the amount of waste that is produced. Sometimes waste reduction is realized as a secondary benefit to process changes that are made for other purposes, such as to improve efficiency or product quality. In addition to reduced generation of waste, benefits such as more energy efficiency or increased production capacity can help offset the costs associated with modifying a process.

A specific type of process change that many electroplaters and metal finishers have found to be cost-effective is to reduce drag-out. Drag-out is the unwanted loss of bath components when an immersed article is removed. Drag-out increases process material and rinsewater use, generates waste and wastewater, and can contaminate downstream baths. Drag-out prevention measures reduce the amount of bath components lost during removal of the rinsed parts.

27. Has your company considered waste reduction when selecting, designing, or modifying a process? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Yes.
☐ No. **(SKIP TO Q.30)**

Other **SPECIFY:** _____

- ☐ **NOT APPLICABLE.**
☐ **DON'T KNOW.**

28. Has your company modified processes or related procedures (e.g., reduced drag-out) in order to generate less waste? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We have changed our process to reduce the amount of waste generated.
☐ We up-graded/modernized our process, which resulted in a less hazardous waste being produced.
☐ As a result of process modification, we were able to cease generating a hazardous waste.
☐ We modified our process and are not satisfied with the results.
☐ We modified our process but have not evaluated the results.

Other **SPECIFY:** _____

- ☐ **WE** have not modified our process(es) or related procedure(s).
(SKIP TO Q. 30)
☐ **DON'T KNOW** **(SKIP TO Q. 30)**

29. What have been the results of the process modification(s) or related procedures you have made at your facilities? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Operational costs have been reduced.
☐ Operational costs have stayed the same or increased.
☐ The amount or toxicity of waste generated has decreased.
☐ The amount or toxicity of waste generated has **not** decreased.
☐ Product quality has improved.
☐ Product quality has stayed the same or declined.
☐ The changes have paid for themselves.
☐ The changes have **not** paid for themselves.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
 > TECHNIQUE IX**

30. Why have you not made any process modifications or related procedures at your facilities to reduce the amount or toxicity of waste being generated? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We are already doing all that can be done to make our process(es) efficient.
- ☐ Lack of information.
- ☐ Shortage of personnel or other resources.
- ☐ The pay-back period would be too long.
- ☐ Such changes would adversely affect our product quality.
- ☐ We do not have management support to fund changes to reduce waste generation.
- ☐ Operator or engineer resistance to change.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

TECHNIQUE IX: WASTEWATER REDUCTION

By minimizing the amount of water used, the quantity of wastewater that is generated can often be reduced. Techniques can range from flow control valves on water hoses to water-level controls on tanks. Employees can also be instructed in the benefits of efficient water usage. The actual amount of wastewater reduced and the pay-back period will vary on a case-by-case basis.

For example, in a metal plating shop the multiple countercurrent cascade rinse process allows rinsewater to flow from one bath to successively "dirtier" baths. Thus, the article is rinsed in the "dirtiest" water first and in the "cleanest" water last. Multiple countercurrent cascade rinsebaths can dramatically reduce wastewater generation, as in the following case:

A plating bath with 33 ounces per gallon of plating material is rinsed from articles until the final rinsewater contains 0.001 ounces per gallon. If the drag-out is 4 gallons per hour, the amount of rinsewater required is

■ single tank	132,000 gal/hr
■ 2 counterflow tanks	740 gal/hr
■ 3 counterflow tanks	26 gal/hr

31. How does your company reduce wastewater generation? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Flow controls are used at all appropriate places where water is used in the process.
- ☐ Rinsewater usage is minimized by specific procedures and equipment.
- ☐ Mechanical cleaning is used instead of using water or other chemicals.
- ☐ Operations are scheduled to increase water use efficiency.
- ☐ Excess water is reused without treatment in other operations.

Other **SPECIFY:** _____

☐ **NOT APPLICABLE.** (SKIP TO Q. 33)

☐ **DON'T KNOW.** (SKIP TO Q. 33)

32. What have been the results of implementing wastewater reduction methods at your plant? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Wastewater generation has been greatly reduced.
- ☐ Wastewater generation has been reduced only somewhat or not at all.
- ☐ Savings in water costs and wastewater treatment/disposal will quickly pay for the changes.
- ☐ Savings will eventually pay for the changes.
- ☐ Savings will not pay for the changes.
- ☐ The equipment and procedures caused operational problems.
- ☐ No operational problems have been noticed.
- ☐ Product quality has improved.
- ☐ Product quality has remained the same.
- ☐ Product quality has declined.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**
- ☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE X**

33. Why haven't you implemented wastewater reduction measures in your facilities? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We already generate minimal wastewater.
- ☐ Lack of information.
- ☐ Estimated costs exceed the benefits.
- ☐ Engineer or operator resistance.
- ☐ Product quality concerns.

Other **SPECIFY:** _____

- ☐ **DON'T KNOW.**

TECHNIQUE X: ONSITE RECYCLING OR RECOVERY FOR REUSE

Recycling is the recovery of materials for reuse. Recycling methods include closed-loop applications that return "wastes" for reuse (such as reclaiming solvents onsite by distillation) and recovery of "wastes" by using them onsite as a fuel. Sometimes a "waste" from a process that requires high purity materials can be used for less demanding purposes.

34. Do you know which "wastes" in your plant can be recycled or reused by yourself or others in your facility? **CHECK ONLY ONE ANSWER.**

- ☐ Yes.
- ☐ No.
- ☐ **DON'T KNOW.**

35. Have you ever recycled or recovered any of your "wastes" instead of sending them to an offsite treatment unit, incinerator, or landfill? **CHECK ONLY ONE ANSWER.**

- ☐ Yes, all recyclable wastes.
☐ Yes, some recyclable wastes.
☐ No. **(SKIP TO Q. 38)**
☐ **DON'T KNOW.** **(SKIP TO Q. 38)**

36. What type of recycling options are used at your plant? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Closed-loop (i.e., in-process) recycling system.
☐ Separate reclamation unit (e.g., solvent still).
☐ "Wastes" made into products.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

37. What have been the results of recycling at your plant? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ We saved money by recycling.
☐ The costs were greater than the savings, e.g., capital costs were greater than operating costs.
☐ There have been no savings or extra costs.
☐ We had benefits other than cost savings.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**
☐ **RESULTS HAVE NOT BEEN EVALUATED.**

**SKIP TO
> TECHNIQUE
XI**

38. Why haven't you recycled your wastes? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ The costs would exceed the benefits.
☐ There are logistical problems (e.g., transportation, scheduling problems).
☐ Concerns about product quality.
☐ Inadequate space for recycling equipment.
☐ Lack of information.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

TECHNIQUE XI: OFFSITE RECYCLING OR RECOVERY FOR REUSE (MATERIALS EXCHANGE)

In a materials exchange, one facility sells or gives a material to another facility that can use it. Materials exchanges have been set up by government agencies and business groups acting as confidential brokers, often at little or no charge to the users. For example, one plant may generate a waste acid and may be able to sell or donate the waste to another plant that generates a caustic waste and can use the "waste" acid as a neutralizing agent.

Some examples of general types of materials included in materials exchanges are:

- | | |
|----------------------------|-----------------------------|
| * acids | * textiles and leather |
| * solvents | * other inorganic chemicals |
| * plastics and rubber | * oils and waxes |
| * metals and metal sludges | * wood and paper |
| * alkalis | * other organic chemicals |

39. Does your company or would your company participate in a materials exchange?
CHECK ONLY ONE ANSWER.

- ☐ Yes, we participate in a materials exchange program.
- ☐ Yes, we would consider participating in a materials exchange program.

Other **SPECIFY:** _____

☐ **NO**, we do not or would not participate.

☐ **DON'T KNOW.**

(SKIP TO Q. 42)

(SKIP TO Q. 42)

40. What types of "wastes" would you like to, or do you already, sell or give to another facility? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Acids.
- ☐ Solvents.
- ☐ Plastics and rubber.
- ☐ Metals and metal sludges.
- ☐ Alkalis.
- ☐ Other organic chemicals.
- ☐ Textiles and leather.
- ☐ Other inorganic chemicals.
- ☐ Oils and waxes.
- ☐ Wood and paper.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

41. What types of "wastes" would you like to, or do you already, buy or receive from another facility? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Acids.
- ☐ Solvents.
- ☐ Plastics and rubber.
- ☐ Metals and metal sludges.
- ☐ Alkalies.
- ☐ Other organic chemicals.
- ☐ Textiles and leather.
- ☐ Other inorganic chemicals.
- ☐ Oils and waxes.
- ☐ Wood and paper.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

☐ **WE would not buy or receive "wastes" from another facility.**
(SKIP TO Q. 42)

**SKIP TO
TECHNICAL
> ASSISTANCE
AVAILABLE
XII**

42. Why doesn't your company participate in a materials exchange? **CHECK ALL ANSWERS THAT APPLY.**

- ☐ Product quality concerns.
- ☐ Believe costs would exceed the benefits.
- ☐ Lack of information.
- ☐ Engineer or operator resistance.
- ☐ Liability concerns.
- ☐ Shortage of personnel or other resources.
- ☐ Lack of management support.

Other **SPECIFY:** _____

☐ **DON'T KNOW.**

XII: TECHNICAL ASSISTANCE SERVICES AVAILABLE

Several states, including Illinois, have industrial technical assistance programs to help generators find solutions to their waste management problems. The technical assistance program in Illinois is located in the Hazardous Waste Research and Information Center (HWRIC), within the non-regulatory Department of Energy and Natural Resources.

The technical assistance services provided by this Illinois program do not determine regulatory compliance. Rather, various types of assistance and information are provided, including site visits, waste reduction audits, referrals, and acting as an intermediary to regulatory agencies.

The Waste Reduction Advisory System (WRAS) is a part of the technical assistance and information services we provide to promote waste reduction. For each of the eleven waste reduction techniques described above, we can provide additional information or offer referral to consultants, waste management firms, waste haulers, and other technical assistance programs. We can also provide case studies and published literature specific to your company's waste streams or processes.

On the following few pages, you can request specific information or technical assistance from HWRIC.

MANAGEMENT STRATEGIES

HWRIC maintains lists of waste reduction training programs, descriptions of employee incentive programs, literature on inventory control systems and purchasing procedures, and general information about waste reduction management policy that other companies have implemented. Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Waste reduction management policy.
- ☐ Waste reduction training programs and seminars.
- ☐ Employee incentive programs.
- ☐ Inventory control systems.
- ☐ Purchasing procedures.

WASTE REDUCTION AUDITS

HWRIC can provide information on waste reduction audit procedures, including the results of audits for various types of industries. In some cases, HWRIC may be able to schedule an initial audit with HWRIC staff or provide referrals to consultants who can offer the specific expertise needed for a particular industry. Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Waste reduction audit manuals.
- ☐ List of consultants who provide waste reduction audits.
- ☐ Regulatory compliance information referral.
- ☐ Initial waste reduction audit with HWRIC staff.
- ☐ Waste reduction audit literature examples for similar facilities or processes.

BETTER HOUSEKEEPING

HWRIC has available for distribution some literature on improved housekeeping practices that have been used to reduce waste generation. Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Preventive maintenance literature.
- ☐ Inventory and purchasing procedures.
- ☐ Descriptions of good housekeeping programs at other companies.

WASTE STREAM SEGREGATION

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Compatibility of waste materials.
- ☐ Case studies of waste stream segregation for facilities similar to yours.
- ☐ Referral to consultants.
- ☐ Equipment lists for waste stream segregation.

PROCESS RAW MATERIALS MODIFICATION OR SUBSTITUTION

HWRIC can assist companies with investigating options for material substitution or modification. Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Case study information on material substitution.
- ☐ Materials compatibility literature.
- ☐ Referral to consultants.

PRODUCT REFORMULATION OR REDESIGN

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Referral to consultants.
- ☐ Technical assistance from HWRIC.
- ☐ Literature case studies on product reformulation or redesign.

EQUIPMENT OR TECHNOLOGY MODIFICATION

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Referral to consultants.
- ☐ Referral to equipment vendors.
- ☐ Technical assistance from HWRIC.
- ☐ Literature case studies on equipment modification.

PROCESS MODIFICATION OR SUBSTITUTION

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Referral to consultants.
- ☐ Case study examples of successful process modifications.

WASTEWATER REDUCTION

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ Flow control literature.
- ☐ Referral to consultants.
- ☐ Case study examples of wastewater reduction.
- ☐ Equipment vendors.

ONSITE RECYCLING OR RECOVERY FOR REUSE

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ List of metal recycling equipment vendors.
- ☐ List of used oil reclamation equipment vendors.
- ☐ List of solvent recycling equipment/vendors.
- ☐ List of other equipment manufacturers/suppliers.
- ☐ Technical assistance from HWRIC.

OFFSITE RECYCLING OR RECOVERY FOR REUSE (MATERIALS EXCHANGE)

Would you like to receive specific information or assistance regarding... **CHECK DESIRED ITEMS.**

- ☐ List of materials exchanges in your area.
- ☐ List of materials exchanges in other areas and Canada.
- ☐ Technical assistance from HWRIC.

If you have requested additional information or technical assistance, please write in your name and address below so that technical assistance program providers can contact you.

Your responses to this questionnaire will only be used internally for providing information to you. Your answers will be compiled in a summary form along with those of other users of the Waste Reduction Audit Checklist (WRAC) questionnaire.

Any public release of the data will be in summary form so it will not be possible to connect specific responses to individual respondents.

☐ Mr. ☐ Ms. _____
 First Name Middle Initial Last Name

Position/Title _____

Organization _____

Address _____

 City State Zip Code

Telephone area code(_____) _____

THANK YOU!

For additional information contact:

Hazardous Waste Research and Information Center
Illinois Department of Energy and Natural Resources
One East Hazelwood Drive
Champaign, Illinois 61820

(217)333-8940

_____ **CHECK HERE IF YOU ARE INTERESTED IN HWRIC PERSONNEL
CONTACTING YOU TO DISCUSS YOUR TECHNICAL ASSISTANCE
REQUESTS.**

APPENDIX C

ILLINOIS TOXIC POLLUTION PREVENTION ACT

ILLINOIS TOXIC POLLUTION PREVENTION ACT

Public Act 86-914

and

ENROLLED AMENDMENTS TO ILLINOIS PUBLIC ACT 86-914

Senate Bill 2253

the Department finds that there exists an effective recycling market in this State.

7903. Research

§ 3. Research. (a) The Department, in cooperation with the Agency, shall undertake a research effort designed to evaluate the degradation process and the environmental impact of degradable plastics, and shall develop and propose to the Pollution Control Board model landfill practices designed to promote the degradation of degradable plastic containers.

(b) The Department shall also conduct a study to evaluate the promotion of degradable plastics as a partial response to the solid waste crisis. The study should concurrently consider the relative merits of other responses, including recycling, incineration and waste reduction programs.

7904. Degradable products

§ 4. Degradable products. The Department shall study the feasibility of developing new products made from degradable plastics, and the economic impact of requiring that certain industrial and consumer goods be manufactured from degradable products.

7905. State purchasing

§ 5. State purchasing. The Department of Central Management Services, and all other departments and agencies of State government, when purchasing plastic containers and other plastic products, shall purchase products that are degradable or recyclable whenever such products are available at reasonable cost and in the appropriate quantity and quality.

TOXIC POLLUTION PREVENTION

AN ACT to promote reduced use of toxic substances by Illinois industries. P.A. 86-914, approved Sept. 11, 1989, eff. Jan. 1, 1990.

7951. Short title

§ 1. Short Title. This Act shall be known as the Toxic Pollution Prevention Act.

7952. Findings

§ 2. Findings. (a) The General Assembly finds:

(1) that significant opportunities may exist for industry to eliminate or reduce the generation of toxic substances at the source through modifications in production, operation and raw materials use;

(2) that such modifications may offer significant savings through reduced raw materials, insurance and pollution control costs and are likely to improve worker health and safety;

(3) that toxic pollution prevention opportunities are not realized because (i) existing regulations focus on treatment and disposal of wastes that have already been generated, rather than reducing the use of toxic substances at the source; (ii) existing regulations do not emphasize multimedia management of waste; and (iii) industries may need technical assistance for toxic pollution prevention;

(4) that State environmental agencies can help promote toxic pollution prevention by disseminating information

about such strategies to a range of industries, both large and small; and

(5) that some industries may require on-site technical assistance from the State.

(b) It is the purpose of this Act to reduce the disposal and release of toxic substances which may have adverse and serious health and environmental effects, to promote toxic pollution prevention as the preferred means for achieving compliance with environmental laws and regulations, to establish State programs that provide high-level attention to toxic pollution prevention policy initiatives, to integrate existing regulatory programs to promote toxic pollution prevention, and to stimulate toxic pollution prevention strategies by industry.

7953. Definitions

§ 3. Definitions. As used in this Act:

"Agency" means the Illinois Environmental Protection Agency.

"Center" means the Hazardous Waste Research and Information Center.

"Person" means any individual, partnership, co-partnership, firm, company, corporation, association, joint stock company, trust, political subdivision, State agency, or any other legal entity, or its legal representative, agent or assigns.

"Release" means emission to the air, discharge to surface waters or off-site wastewater treatment facilities, or on-site release to the land, including but not limited to landfills, surface impoundments and injection wells.

"Toxic substance" means any substance listed by the Agency pursuant to Section 4 of this Act.¹

"Toxic pollution prevention" means in-plant practices that reduce, avoid or eliminate: (i) the use of toxic substances, (ii) the generation of toxic constituents in wastes, (iii) the disposal or release of toxic substances into the environment, or (iv) the development or manufacture of products with toxic constituents, through the application of any of the following techniques:

(1) input substitution, which refers to replacing a toxic substance or raw material used in a production process with a nontoxic or less toxic substance;

(2) product reformulation, which refers to substituting for an existing end product an end product which is nontoxic or less toxic upon use, release or disposal;

(3) production process redesign or modification, which refers to developing and using production processes of a different design than those currently used;

(4) production process modernization, which refers to upgrading or replacing existing production process equipment or methods with other equipment or methods based on the same production process;

(5) improved operation and maintenance of existing production process equipment and methods, which refers to modifying or adding to existing equipment or methods, including but not limited to such techniques as improved housekeeping practices, system adjustments, product and process inspections, and production process control equipment or methods;

(6) recycling, reuse or extended use of toxic substances by using equipment or methods which become an integral part of the production process, including but not limited to filtration and other closed loop methods.

1 of the waste reduction plan shall be designed to achieve, by 1366
 2 January 1, 2000, at least a 40% reduction (referenced to a 1367
 3 base year of 1987) in the amount of solid waste that is 1368
 4 generated by the institution and identified in the waste 1369
 5 reduction plan as being subject to landfill disposal.
 6 (e) Each waste reduction plan shall evaluate the 1371
 7 institution's procurement policies and practices to eliminate 1372
 8 procedures which discriminate against items with recycled 1373
 9 content, and to identify products or items which are procured 1374
 10 by the institution on a frequent or repetitive basis for 1375
 11 which products with recycled content may be substituted.
 12 Each waste reduction plan shall prescribe that it will be the 1376
 13 policy of the institution to purchase products with recycled 1377
 14 content whenever such products have met specifications and 1378
 15 standards of equivalent products which do not contain 1379
 16 recycled content.
 17 (f) Each waste reduction plan developed in accordance 1381
 18 with this Section shall be submitted to the Department of 1382
 19 Energy and Natural Resources for review and approval. The 1383
 20 Department's review shall be conducted in cooperation with 1384
 21 the Board of Higher Education and the Illinois Community 1385
 22 College Board.
 23 (g) The Department of Energy and Natural Resources shall 1387
 24 provide technical assistance, technical materials, workshops 1388
 25 and other information necessary to assist in the development 1389
 26 and implementation of the waste reduction plans. The 1390
 27 Department shall develop guidelines and funding criteria for 1391
 28 providing grant assistance to institutions for the 1392
 29 implementation of approved waste reduction plans.
 30 Section 2004. The Toxic Pollution Prevention Act is 1395
 31 amended by changing Sections 4 and 5 as follows: 1396
 32 (Ch. 111 1/2, par. 7954) 1399
 33 Sec. 4. Toxic Pollution Prevention Program. There is 1401

1 hereby established within the Agency a Toxic Pollution 1403
 2 Prevention Program. The Program, at a minimum, shall:

3 (1) Identify all federal and State laws or regulations 1406
 4 pertaining to waste disposal and release of toxic substances
 5 into the environment. The Program shall promote increased 1407
 6 coordination of efforts to administer and enforce these laws 1408
 7 and regulations, review draft administrative rules before 1409
 8 submission to determine their potential impact on toxic 1410
 9 pollution prevention and shall--also determine how Agency 1411
 10 programs should be coordinated or modified to promote toxic 1412
 11 pollution prevention.

12 (2) Develop a toxic pollution prevention manual for 1415
 13 Agency inspectors and permit reviewers.

14 (3) Establish procedures for expediting permit 1418
 15 application review for process or equipment modifications
 16 that involve toxic pollution prevention. 1419

17 (4) Develop a list of toxic substances which it believes 1421
 18 should receive priority consideration for toxic pollution 1422
 19 prevention based upon an examination of toxic release 1423
 20 inventory reports filed with the Agency pursuant to Section 1424
 21 313 of the federal Emergency Planning and Community Right to 1425
 22 Know Act of 1986. The Program shall take into account
 23 available health and environmental effects data, volumes of 1426
 24 toxic releases and degree of hazard. The Program shall 1427
 25 review and update the list at least once every 2 years. 1428

26 (5) Establish, in cooperation with the Center, methods 1430
 27 and procedures for managing toxic pollution prevention 1431
 28 information and for assessing the progress of toxic pollution 1432
 29 prevention statewide.

30 (6) To the extent practicable, use the forms, practices 1434
 31 and procedures already in place in established environmental 1435
 32 protection programs.

33 (Source: P.A. 86-914.) 1437

34 (Ch. 111 1/2, par. 7955) 1440

1 Sec. 5. Toxic Pollution Prevention Assistance Program. 1442

2 There is hereby established a Toxic Pollution Prevention 1443

3 Assistance Program at the Hazardous Waste Research and 1444

4 Information Center. The Center may establish cooperative 1445

5 programs with public and private colleges and universities 1446

6 designed to augment the implementation of this Section. The

7 Center may establish fees, tuition, or other financial 1447

8 charges for participation in the Assistance Program. These 1448

9 monies shall be deposited in the Toxic Pollution Prevention 1449

10 Fund established in Section 7 of this Act. Through the 1450

11 Assistance Program, the Center:

12 (1) Shall provide general information about and actively 1452

13 publicize the advantages of and developments in toxic 1453

14 pollution prevention.

15 (2) May establish courses, seminars, conferences and 1455

16 other events, and reports, updates, guides and other 1456

17 publications and other means of providing technical 1457

18 information for industries, local governments and citizens 1458

19 concerning toxic pollution prevention strategies, and may, as

20 appropriate, work in cooperation with the Agency. 1459

21 ~~(3)--May--develop--and--provide--curriculum--and--training--for~~ 1461

22 ~~students--and--faculty--on--toxic--pollution--prevention--~~ 1462

23 (3) ~~(4)~~ Shall engage in research on toxic pollution 1464

24 prevention methods. Such research shall include assessments 1465

25 of the impact of adopting toxic pollution prevention methods 1466

26 on the environment, the public health, and worker exposure, 1467

27 and assessments of the impact on profitability and employment 1468

28 within affected industries.

29 (4) ~~(5)~~ Shall May provide on-site technical consulting, 1471

30 to the extent practicable, to help facilities to identify 1472

31 opportunities for toxic pollution prevention, and to develop

32 toxic pollution prevention plans. To be eligible for such 1474

33 consulting, the owner or operator of a facility must agree to

34 allow information regarding the results of such consulting to 1475

35 be shared with the public, provided that the identity of the 1476

1 facility shall be made available only with its consent, and 1477
2 trade secret information shall remain protected.

3 (5) (6) May sponsor pilot projects in cooperation with 1479
4 the Agency, or an institute of higher education to develop 1481
5 and demonstrate innovative technologies and methods for toxic
6 pollution prevention. The results of all such projects shall 1482
7 be available for use by the public, but trade secret 1483
8 information shall remain protected.

9 (6) May award grants for activities that further the 1485
10 purposes of this Act, including but not limited to the 1486
11 following:

12 (A) grants to not-for-profit organizations to establish 1488
13 free or low-cost technical assistance or educational programs 1489
14 to supplement the toxic pollution prevention activities of 1490
15 the Center;

16 (B) grants to assist trade associations, business 1492
17 organizations, labor organizations and educational 1493
18 institutions in developing training materials to foster toxic 1494
19 pollution prevention; and

20 (C) grants to assist industry, business organizations, 1496
21 labor organizations, education institutions and industrial 1497
22 hygienists to identify, evaluate and implement toxic 1498
23 pollution prevention measures and alternatives through 1499
24 audits, plans and programs.

25 The Center may establish criteria and terms for such 1502
26 grants, including a requirement that a grantee provide 1503
27 matching funds. Grant money awarded under this Section may
28 not be spent for capital improvements or equipment. 1504

29 In determining whether to award a grant, the Director 1506
30 shall consider at least the following: 1507

31 (i) the potential of the project to prevent pollution; 1509
32 (ii) the likelihood that the project will develop 1511
33 techniques or processes that will minimize the transfer of 1512
34 pollution from one environmental medium to another; 1513
35 (iii) the extent to which information to be developed 1515

1 through the project will be applicable to other persons in 1516
2 the State; and

3 (iv) the willingness of the grant applicant to assist 1518
4 the Center in disseminating information about the pollution 1520
5 prevention methods to be developed through the project.

6 (7) Shall establish and operate a State information 1522
7 clearinghouse that assembles, catalogues and disseminates 1523
8 information about toxic pollution prevention and available 1524
9 consultant services. Such clearinghouse shall include a 1525
10 computer database containing information on managerial,
11 technical and operational approaches to achieving toxic 1526
12 pollution prevention. The computer database must be 1527
13 maintained on a system designed to enable businesses, 1528
14 governmental agencies and the general public readily to
15 obtain information specific to production technologies, 1529
16 materials, operations and products. A business shall not be 1530
17 required to submit to the clearinghouse any information that 1531
18 is a trade secret.

19 (8) May contract with an established institution of 1533
20 higher education to assist the Center in carrying out the 1534
21 provisions of this Section. The assistance provided by such 1535
22 an institution may include, but need not be limited to: 1536

23 (A) engineering field internships to assist industries 1538
24 in identifying toxic pollution prevention opportunities; 1539

25 (B) development of a toxic pollution prevention 1541
26 curriculum for students and faculty; and 1542

27 (C) applied toxic pollution prevention and recycling 1544
28 research.

29 (9) Shall emphasize assistance to businesses that have 1546
30 inadequate technical and financial resources to obtain 1547
31 information and to assess and implement toxic pollution 1548
32 prevention methods.

33 (10) {7} Shall publish a biannual report on its toxic 1550
34 pollution prevention activities, achievements, identified 1551
35 problems and future goals.

